ELECTRICAL REVIEW
AND
WESTERN ELECTRICIAN

VOL. LIX, No. 24. CHICAGO, SATURDAY, DECEMBER 9, 1911. ISSUED WEEKLY

BY THE

ELECTRICAL REVIEW PUBLISHING COMPANY

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PUBLICATION OFFICE: MARQUETTE BUILDING, CHICAGO

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SUBSCRIPTIONS.

One Year, United States $3.00
One Year, Canada 4.00
One Year, Foreign Countries 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each . .25

Entered as second-class matter, November 7, 1908, at the Post Office at Chicago, Ill, under the Act of March 3, 1879.

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TELEVISION.

A step in electrical invention that may well mark the beginning of a period of investigation of an instrument as high in industrial usefulness as the telephone or telegraph was taken when Mr. A. A. Campbell Swinton developed the theoretical method of television recently presented to the Röntgen Society in England. Although the ideas brought forward by Mr. Swinton have not yet even reached the experimental stage, the ingenuity of his method is quite apparent. He has seized the idea of a simple method and by analysis deduced its probable workings. With the knowledge gained by experiment, doubtless some changes will have to be made, but with results even as near to life as those produced by the average moving-picture machine the invention would be a distinct step forward. It is certainly no more difficult of achievement than either the moving-picture machine or the telephone must have appeared a few decades ago.

The mechanism, if it may be called such, indeed resembles that of the moving-picture machine, except that instead of seeing a succession of images, the observer sees the composite picture due to a dot of light appearing successively at different points and moving over the screen in a systematic manner, and in each cycle covering its entire surface. The image seen by the observer would be the combination of many retained impressions of the moving spot.

While some of the ideas involved in the television scheme may be old, the idea of entirely replacing the moving parts by two synchronously displaced cathode-ray discharges is certainly novel. With this weightless moving part and pairs of magnets for the horizontal and vertical movements supplied from the same circuits, there can be no danger of the receiving and sending end of the instrument falling out of step.

Should Mr. Swinton's idea be taken up and worked out, there would seem to be no lack of commercial opportunities for it. Races, contests and games may in the future be presented to audiences in a distant hall in synchronism with their actual performance. Spoken words have now quite largely taken the place of written messages, but space has not yet been overcome to a sufficient degree. The public wants long-distance sight as well as conversation, and if Mr. Swinton's ideas reach fruition, it will have it.

IMPROVING DISTRIBUTION CIRCUITS.

The extension of central-station service into wider fields opens to many managers a valuable opportunity for the improvement of distribution and moderate-voltage transmission circuits. As the policy of centralized power generation takes its place in the management of small companies as well as in the expansion of large urban systems, the increase in loads and need of improved regulation at points more and more remote from the plant put the burden of betterment work in the distribution system upon the progressive operating organization. As the service is extended into small towns more or less distant from the former center of distribution, it frequently becomes imperative to rebuild old lines, or to rehabilitate sections of existing circuits in connection with supplementing them by new transmission and feeder layouts.

In a representative case of this kind, the lighting company extended its service into new rural and suburban areas formerly having little or no connection with the main system, and handicapped by geographical conditions tending to interfere with the reliability of the energy supply. The improvement of the system included the building of a new direct line from the generating plant to the new territory, utilizing the old pole line in part so far as it traversed the highways in serving communities near the towns taken into the network; the installation of short-cut sections of line on rights of way secured across country, pole locations being all that had to be purchased; the avoidance of trees and connection of double taps to important mill installations, so that the regularity of the service could be better insured; and the installation of new cross-arms, straightening of poles and replacement of an odd size of wire in one of the three phases of the original line by a larger size, equivalent to the cross-section of the other two phases.

The most distant town formerly supplied by the company was previously provided with a small distributing substation, poorly located with respect to the supply of current to various mills in a nearer community which was not as a whole a user of the company's energy until the time arrived for the rehabilitation of the general system. A feature of the improvement plan was, accordingly, the relocation of the substation; and with this change the company adopted a secondary distribution potential of 4,600 volts, feeling that the standard 2,300-volt service could not properly supply consumers scattered over the wider areas included in the new territory. In this move the company forecasted a change in central-station practice which is likely to become general within a few years, in view of the great economy in copper secured and the reliability of insulation at all points where its mechanical stability can be maintained.

By carful planning and close attention to the salvage gained from the sale of useless material, the work was carried through at moderate expense, and the system established on a much improved operating basis. Individual consumers were assured more reliable service, and by the employment of considerable equipment from the old line in local distribution at reduced loads and voltage, money was saved. In themselves, the changes effected were of the character which any careful manager would readily set about making; but taking them as a whole, they illustrated how much can be done at reasonable expense to modernize a rapidly growing distribution system and render its service of larger value to the consuming public. Many similar opportunities for improvement may be found in other small systems covering considerable areas.

ELECTRICAL RESISTANCE OF THE HUMAN BODY.

Electric conduction in the human body appears to be largely electrolytic. The measured resistance of the body varies greatly, not only in different individuals, but even in the same individual. One very variable element is the contact resistance of the skin. When very dry the skin may be regarded as an insulator, and it is then possible to retain static charges upon definite portions of the body. When moist, not only on the surface, but by having the pores full of liquid matter, the resistance is very much reduced, and conduction of high-frequency currents then becomes largely a surface phenomenon. Otherwise it is a capacity phenomenon, the body acting as a condenser.

The very great difference in fatality of shocks received under different conditions, and by different persons, is more readily understood by a consideration of this contact resistance. Ordinarily more than 500 volts, from a source capable of maintaining a current, is necessary to produce death in a human being, and yet cases are on record where 110 volts have proved fatal. In addition to the variable resistance of the contacts we have also to deal, in such cases, with the different possibilities for the path of the current through the body and with the variations in the ground resistance, since a ground connection is usually involved in receiving a shock.

That conduction through the bodily tissues and fluids is largely electrolytic, and is accompanied by a migration of ions, may be shown by moistening an anode with strychnine sulphate, in which case poisoning will ensue, while if the cathode is so treated no such effect results. On the other hand, if the cathode is moistened with potassium cyanide, the cyanogen ion is transported into the body and again poisoning results. It is probable that similar electrolytic effects take place within the body, wherever a membrane separates two fluids which are acting as electrolytes.

The effect of ionic penetration in the skin is to alter the conductivity of that portion of the body, and it has been observed that the passage of a current reduces the resistance of the body. The conditions are somewhat analogous to those in the coherer of a wireless-telegraph apparatus, except that the initial resistance is not so high.

GASOLINE VEHICLES MENACE PUBLIC HEALTH.

When Mr. Edison launched his tirade against horse-drawn vehicles a few years ago on the ground that the litter due to the horses and their feed produced an unsightly and unsanitary condition of the streets which we are trying hard to keep clean, his arguments were promptly echoed by automobile makers and dealers in the larger cities. For once the noted inventor seemed to be on the same side with the manufacturers of gasoline vehicles, for his prophecy of city streets from which horses would be barred was in line with their own aims. Yet in its fundamentals, Mr. Edison's position could be strictly construed as accruing only to the benefit of electric vehicles, for his plea was not only against the unsightly littering of the street surfaces but more particularly against the disagreeable and unsanitary effect of having that litter scattered through the air which both pedestrians and drivers of vehicles are obliged to breathe. The moment the question of the effect on the street air entered the consideration, the electrics alone were faultless, for the gasoline machines are notorious as undesirable perfumers of the atmosphere.

It had been commonly supposed that the vapor and odor of the exhaust from the gasoline automobiles, while momentarily disagreeable if inhaled at close range, had no deleterious effect on the health of those obliged to breathe the same. That still is the generally accepted opinion. But, as pointed out in another column, the momentary unpleasantness of such exhausts is as nothing compared with the really serious action of the two strong poisons common to such exhausts—the carbon monoxide due to imperfect combustion and the aldehyde produced by the distilling of the almost unavoidable surplus of lubricating oil. The researches of Mr. Dugald Clerk (the well known British authority on internal-combustion engines) indicate that under laboratory conditions the adjustment of the carbureter, the positioning and timing of the ignition devices, and the temperature of both engine and carbureter may be such as to preclude the formation of the poisonous carbon monoxide. But even the most careful laboratory adjustment would immediately be spoilt in its effectiveness by a change in the quality of the gasoline and to some extent by variations in the weather. In practice, very few autos are handled by men who could be depended upon to do such adjusting with a certainty of securing the proper result. The same holds true as to adjusting the exact amount of lubricating oil to prevent the formation of that obnoxious constituent of gasoline exhausts which was at first thought to be acetylene but which the more recent investigations at Berlin class among the aldehydes.

Consequently, the prospect of reducing the production of these health-menacing gases is by no means a bright one unless strong efforts are made in other directions. Legislation may help, but even in Europe the laws aimed at reducing this evil are worded as referring to "avoidable" fumes and obnoxious gases, leaving the burden of proof upon the public prosecutors to show that the same are avoidable. The real relief would seem to lie more in education—education of the owners of gasoline cars as to the seriousness of the exhaust gases, of the public as to the danger of letting such fumes and gases concentrate in congested places, and of physicians as to the reasons for symptoms of poisoning which may otherwise be mystifying to them. Such an educational campaign should deserve the hearty support of the electrical fraternity not only because all members of it are exposed to the dangerous fumes, but also because a more general understanding of the air vitiation due to gasoline cars will aid in speeding the predominance of electric vehicles.

WIRING FOR CHRISTMAS.

The approach of the Christmas season presents many opportunities for special electrical displays which will add at least temporarily to the business of the central station. Christmas trees are very largely displayed in stores and show windows as well as in the home. The incandescent lamp furnishes the only safe method of illuminating the tree. Very many fires have been caused in the past by the use of candles and other means of ornament, and no decorations of this kind should be permitted where electric current is available.

Wiring of this temporary kind is often done by persons who do not properly realize the risks involved through lack of the necessary precautions in handling electrical circuits. Any fires or other troubles resulting from the use of electric current militate against the further use of it by others and tend to throw the method into disrepute. The central station should consequently exercise an oversight whenever possible to see that the temporary wiring is done in accordance with local regulations and underwriters' rules. The central station has sufficient interest in the matter to have its men use the necessary time for this purpose. A sufficient argument for making the consumer conform to the requirements is the fact that a disregard of the underwriters' rules will subject him to the possible loss of his insurance in case of a fire, since all policies provide that if there be a material increase in hazard, without permission, the insurance shall be void.

In addition to proper wiring, suggestions should be made for the elimination of inflammable decorations. Cotton batting, which is so commonly used to give the appearance of snow, may be readily replaced by asbestos, magnesia or other fireproof material. Similarly, noninflammable substitutes can be provided for hair, tinsel, etc. It is not always realized that if paper or cloth or other inflammable material is left in contact with an incandescent lamp, it will ultimately be charred and probably caused to blaze. It is therefore necessary that the lamps should be kept free from contact with any other material.

November Meeting of the Empire State Gas and Electric Association.

The first of the sectional meetings of the Empire State Gas and Electric Association for the new association year was held in Syracuse, N. Y., on November 22, the topic for discussion being street lighting.

The chairman of the Committee on Arrangements, H. W. Peck, of Rochester, presided at the opening session in the rooms of the Technology Club. The first speaker was Mr. Kennedy, of the local central-station company, who welcomed the members and outlined the purpose of the meeting. He was followed by H. Thurston Owens, of New York City, who described the lighting conditions in the streets of many European cities and compared them with the newer installations in this country, the talk being fully illustrated by means of stereopticon views. Talks on construction work in New York City, by Mr. Dempsey, "white-way" lighting in Syracuse, by Mr. Dudley, and the combination trolley and lighting installation in Poughkeepsie, by Mr. Sherck, completed the morning program.

The fifty odd members in attendance then enjoyed luncheon at the Hotel Onondaga after which they returned to the meeting rooms. After a few routine matters were disposed of, the street-lighting installation at Auburn was described by Mr. Reynolds. Mr. Montagnani, of Rochester, followed by showing the various types of posts and poles used in that city, especially those made of concrete. Gas lighting in Westchester County was described by G. T. Macbeth. This closed the formal talks.

The meeting was then open for general discussion, the principal points considered being the difference between European and American practice. Large high-candlepower units are the general practice abroad, while the cluster type is more generally used in this country. The use of tungsten lamps on the same circuits as magnetite arcs brought out considerable comment both pro and con, but no definite suggestion as to remedying trouble due to excessive loads burning out the tungsten lamps was brought out.

The point which came in for the most discussion was that of ornamental versus regular street-lighting installations. Very few of the so-called "white-way" installations are paid for by the city at large and many were inclined to the belief that the merchants who pay the bill will tire of this method of attracting trade. The advocates of this method felt that, should that time arrive, the city will take over the installations and operate them. The fact that these installations give a city considerable prominence at present is sufficient reason for making them.

In addition to the members who provided illustrated talks the discussion was entered into by Messrs. Ryan, of Schenectady; Macbeth, of Bloomfield, N. J.; Durfee, of Rochester; Brayton, of Utica, and many others. From the attendance and the interest in the meeting the method of limiting the sectional meetings to one subject proved a great success and will be continued.

Engineering Electrostatics.

On December 5 the Schenectady section of the American Institute of Electrical Engineers met in Red Men's hall to hear and discuss a paper on "Fundamentals of Electrostatics," by William S. Franklin, professor of physics at Lehigh University.

During the past few years a great amount of attention has been given to the investigation, development, and transmission of power at high voltages and although the designing engineer, as such, has done admirable work in this connection, he, however, would not have been able to make such material advances in his line if it were not for the activities which have been carried out in the laboratory. Professor Franklin discussed the fundamentals of electrostatics from the viewpoint of a physicist and imparted to many a better understanding of the difficulties which have been and need yet to be overcome in the development of apparatus to be used in connection with high-voltage electric power.

Nela Engineering Society Formed.

An organization to be known as the Nela Engineering Society has recently been formed by the members of the engineering department of the National Electric Lamp Association, Cleveland, O. At the meetings to be held papers covering subjects of general engineering interest will be presented by members of the society and by outside speakers, and discussions of the various topics will be taken up. Twenty-five persons were present at the organization of the society, which will meet every Thursday evening. M. D. Cooper was elected president.

Edison's Invention to Relieve Taft.

Thomas A. Edison was a visitor to Washington, D. C., on November 27, making a call on President Taft and being present at a test of his small ordnance-cell storage battery at the Washington Navy Yard.

While in Washington Mr. Edison discussed with a representative of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN two very interesting subjects. One of these was in the nature of a prediction that electricity will eventually perform every function on a battleship now exercised by steam, oil and gasoline. The other subject was his new machine, which combines the phonograph and the moving-picture principle, by which an audience can see on a screen the person enunciating the words which the phonograph sends to the ear.

"The time is coming, not far off, when electricity will perform every function on a battleship now exercised by steam, oil and gasoline," Mr. Edison said. "Not only will electricity be used as it is now to move and handle the big guns, hoist ammunition and control the intricate machinery of the fire-control system, but electricity will eventually be the actual motive power by which the battleships and other big ships of the Navy are propelled. The limit has not yet been reached as to the possibilities of electricity on battleships."

Speaking of his new phonograph-moving-picture machine, Mr. Edison said:

"With this machine the audience not only sees the gestures and action of the speaker, but hears his voice. A machine of this sort can naturally be put to countless uses. Perhaps one of the most suitable to suggest at this time is that of its possibility for campaign purposes."

Mr. Edison told President Taft of the possibility of using this machine for campaign purposes, and called his attention to the fact that its use by President Taft might in future save the President thousands of miles of traveling.

Mr. Edison did not care to say how nearly he has perfected the machine. He said that after witnessing the tests at the Navy Yard he was thoroughly impressed with the idea that a great and comprehensive storage-battery system would solve any problems of economy in the conduct of the warships.

W. T. Gentry.

Among the many men who had to do with the early days of the telephone industry but few are today conspicuous in the management of the great organizations which have become the successors of the modest institutions of thirty years ago. Prominent among the men today who wield a master influence over the destinies of the larger companies in the telephone field is W. T. Gentry, president of the Southern Bell Telephone & Telegraph Company, a $30,000,000 corporation with millions of property in seven Southern States and with 6,000 employees.

Mr. Gentry was born in Gordonsville, Va., and began his career with the Southern Bell twenty-eight years ago as manager of the local exchange in Alexandria, Va. A few years later he went to Atlanta, Ga., as manager of the exchange there. From then on until now the story of his rise and the Southern Bell's development has been one of remarkably continuous progress.

When Mr. Gentry went to Atlanta the exchange had less than 100 subscribers and the telephone business was in its infancy. It was hard to bring about a generous use of the telephone, and for a long time headway was hard to make. Today the Atlanta exchange has approximately 14,000 subscribers and in that city at least the service is a social and commercial necessity.

Shortly after Mr. Gentry went to Atlanta he was made assistant district superintendent. In 1907, he was elected vice-president, and in February, 1909, he was elected president of the company. He has filled every position of importance in the organization and he is regarded as one of the ablest telephone men in the country. He has unbounded faith in the present and future possibilities of the South, and his fine capacity for analysis and his interpretation of the tendencies of the times in that country have made him a figure of imposing proportions. He has always adopted a policy of frankness with respect to the relations of his company with the public, and because of this disposition he has surrounded himself and his organization with a host not only of employees, colleagues and customers, but staunch friends and well-wishers.

W. T. GENTRY,
President, Southern Bell Telephone Company.

Spokane Engineers Discuss Electrical Thawing of Water Pipes.

At a recent meeting of the Spokane (Wash.) Chapter of the National Association of Stationary Engineers there was a general discussion of electric thawing of frozen water pipes. The simplicity and effectiveness of the process were clearly pointed out by several speakers and a portable electric thawing outfit for the purpose was described.

New Tube Service Begins in New York.

The first train of the Pennsylvania-Hudson-Manhattan Rapid Transit line between Manhattan and Newark, N. J., left the morning of November 26 one minute after midnight, opening a twenty-minute service between the two cities. Trains left Herald Square from the Hudson tube station on a schedule that took Newark passengers to their home station in thirty-eight minutes.

Smoke Abatement and Electrification.

The committee of investigation of smoke abatement and electrification of terminals in Chicago made its first report of progress last week. This work is described in an address by the president of the Association of Commerce made at the recent municipal dinner.

President Wheeler said in part:

"There are about 1,700 railroad locomotives operated daily within the city limits, and the devices which have been found efficient in smoke consumption are blowers, brick arches, steam jets and fire doors. Of 1,600 locomotives on record in the offices of this committee 90 per cent are equipped with blowers, 40 per cent are equipped with brick arches, 70 per cent are equipped with steam jets and 72 per cent with fire doors.

"Experiments are being made with the Crawford under-feed stoker, and so successfully does this device seem to operate that if no weakness is found in the mechanism and its operation under hard usage, the problem of smoke emission on railroad locomotives will be solved almost completely.

"Jointly with the analysis of smoke and its effect, inquiry is being instituted into the possibility of electrification. Already a survey has been made to ascertain the trackage which must be considered within the city, aggregating 600 miles of first and second main track and 1,700 miles of sidings, yards, etc. To this must be added 1,258 miles of track in the smoke zone, giving some conception of the magnitude of the problem, the cost and feasibility of which the committee has set itself to ascertain.

"This great survey has for its object a triple purpose: first, to ascertain by complete co-operation of all the railroad lines how many locomotives may be cut out of service within the city limits by an agreement for the joint use of motive power; second, how much through freight may be diverted around the city; third, cost and feasibility of electrification.

"Our investigation is of international

interest, for nowhere does a parallel situation exist. Here may be studied scientifically, under the most favorable circumstances, an evil which has troubled the world for centuries. Here may be studied a railroad terminal proposition which for magnitude with respect to trackage and motive power is unequaled."

Send Us Your Ideas.

The ELECTRICAL REVIEW AND WESTERN ELECTRICIAN realizes that among its readers there are many who can offer excellent suggestions for the accomplishment of things in which other readers are interested. Almost everyone can make a suggestion for the guidance and instruction of some other reader. This journal wishes to render the maximum of service to the manager of the central station, to the electrical contractor, to the dealer in electrical material and the manufacturer of current-consuming devices.

We want each reader who has such an idea which will be helpful to others to send it in for publication. We consequently make a standing offer of $5.00 for the best idea, article or suggestion printed in each issue. For every item used we will pay at our regular rates, with a minimum of $1.00.

In the central-station department we want suggestions respecting methods of introducing applications of electrical energy to every kind of industry, examples of co-operation with churches, business and civic organizations for demonstration and trial installations, street lighting, illuminated street parades, window dressing, special sign campaigns, and advertising and selling methods of every description.

In the department devoted to the electrical contractor we want suggestions respecting shop systems, estimating, wiring, construction methods, getting business, exposed conduit wiring, wiring with wooden molding, wiring with flexible conduit and cable, wiring with iron conduit, new wiring in buildings already wired, wiring for alternating-current and direct-current service, wiring for signal systems, annunciator and bell systems, wiring for elevator service, both cage-controlled and automatically operated from floor landings.

In the section devoted to jobbers and supply-men we want suggestions respecting the handling of shelf material, warehouse stocks, ticketing of new material, follow-up systems as an aid to inventory and the elimination of dead stock, writing of orders, express service in the handling of small orders for a large variety of material, methods of packing fragile material to eliminate breakage, credits, etc.

Contributions should be written plainly on one side of the paper, giving full name and address of the author. Payment will be made immediately upon publication. Contributions should be addressed to "Suggestions," ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, 507 Marquette Building, Chicago, Ill.

The new departments will be started in the issue of January 6, 1912.

Public Utilities and Progress.

The December meeting of the Commonwealth Edison Branch of the National Electric Light Association, at which Henry M. Byllesby was the principal speaker, exceeded all previous monthly meetings in point of attendance, there being 550 present.

In opening the meeting Chairman Schuchardt announced that in accordance with plans previously mentioned, prominent men in the community would be asked to address the section at the monthly meeting. Acceptances have already been received from Samuel Insull, Judge Grosscup, B. E. Sunny and B. I. Budd. In order not to neglect the regular work of the Section, bi-monthly meetings will be held at which members from the various departments will be invited to present papers on pertinent topics. An innovation will be the dividing of the membership, for the present, into two sections: technical and commercial. O. R. Hogue has been appointed chairman of the Commercial Section and P. Junkersfeld, chairman of the Technical Section.

Before the address of Mr. Byllesby, Chairman Schuchardt called upon Samuel Insull to deliver the introductory address. Mr. Insull sketched briefly the life of Mr. Byllesby from his graduation from college to the present time, paying a high tribute to him as a pioneer in central-station activities. Paralleling the career of Mr. Byllesby, who is a leader in central-station finances, is that of Frederick Sargent, who, Mr. Insull said, is a leader in central-station engineering.

Mr. Byllesby, in opening, spoke of the wonderful development that has taken place in the central-station industry during the last thirty years. The gas industry, which in the early days of electricity had already been in existence over fifty years, had made no appreciable advance until faced with electric competition. This influence was also evident in railways and even in water works. Mr. Byllesby said that the development which has characterized the electrical industry has been due, in a large measure, to the personnel of the men who have been identified with the industry.

In addition to the influence which the electric central station has had on other public utilities, Mr. Byllesby stated that it wields an influence on the city in which it is located. Illustrating this, Mr. Byllesby cited examples where properties were acquired in localities apparently "dead." Upon installing modern equipment and replacing the employees with men of modern ways and ideas the cities have entered into new eras of prosperity and progress.

Mr. Byllesby briefly traced the development of the two-wire, three-wire and alternating-current systems; also of prime movers, generators, etc. In conclusion he urged the men engaged in the business to realize the opportunities that are before them to become the future leaders and "pioneers," for the next thirty years will see a development equally as great as during the past.

Musical numbers were rendered during the evening by Commonwealth Edison talent.

The fourth annual banquet of the Section was held November 1 at which the following officers were elected for the ensuing year:

Chairman, R. F. Schuchardt.
Vice-chairman, W. C. Berry.
Secretary, C. B. Crothers.
Treasurer, W. A. Fox.

The new members of the Executive Committee are: W. J. Dooner, W. Wardell and F. A. Kaup.

New York Electrical Society Meeting.

The 306th meeting of the New York Electrical Society will be held at the Engineering Societies Building, 29 West Thirty-ninth Street, Tuesday, December 12, at 8 p. m.

Louis Livingston Seaman will lecture on "A Scientific Hunting Expedition in Central Africa, with Special Reference to the Tsetse Fly and the Sleeping Sickness."

Electric or Mechanical Power From the Sun's Rays.

Either electrical energy for lighting service, mechanical power from pumping or other work may be generated from the heat of the sun's rays by the use of the Shuman system indicated in the accompanying illustrations. A complete sun power plant is shown in Fig. 1. It pumps 3,000 gallons of water per minute to a height of 33 feet. Fig. 2 shows the heat absorber and the entire plant in action.

It is held by Frank Shuman that throughout Arizona, Nevada, New Mexico and Southern California there is an opportunity for any amount of power for irrigating purposes alone. These states show an average of ninety per cent sunlight, and the cost of fuel is practically prohibitive in most of this region. He points out the fact that in Egypt agriculture depends entirely upon irrigation furnished by the River Nile through its periodic overflow. The English Government built the Assouan dam at an enormous expense, and widened the irrigable area about half a mile on each side of the Nile, thus adding greatly to the tillable portion of Egypt. Of course, when the Nile is in flood, infinitely more water than necessary is furnished; but the demand is for a supply which can be depended on from day to day, especially at seasons of low water. This supply at present is furnished by the hand labor of some 100,000 fellaheen who pump by means of the shadoof method. One sun engine such as is now erected in Tacony, Pa., will do the work of about a thousand of these laborers.

It is held that ten per cent of the earth's land surface will eventually depend upon sun power for all mechanical operations. Given inexhaustible power, which is, of course, always obtainable from the sun, and utilizing the nitrogen in the air for fertilizer in the form of nitrates and such compounds as calcium cyanamide, the human race will be enabled to draw directly on the source of all life for power and sustenance.

It is conceded that the possibilities of a general use of sun power depends on the cost of the apparatus. It is claimed that the Shuman sun-power plant, including the engine, condenser and auxiliaries, is similar to those in daily use by steam plants, and may therefore be eliminated from comparison, leaving the absorber and the ordinary steam boiler alone to be compared. It is found that at this time the initial cost of the sun-heat absorber in question is about double that of a first-class boiler plant of equal power. The great economy occurs in the item of fuel. In districts especially suitable for sun power the cost of coal, or its equivalent, is usually very high, the price ranging generally from $10 to $30 per ton. To offset this, no fuel at all is required by the sun heater.

It is maintained that in the matter of maintenance and repairs also the advantage lies with the sun power. It is estimated that the repairs should not be in excess of five per cent per year on the initial cost, inasmuch as the apparatus works at low temperature, while the ordinary boiler requires flue gases up to 2,500 degrees. This wear on the parts must manifestly be much greater in the latter form of power plant.

It is pointed out that many parts of the sun-power plant, such as metal heaters, piping, foundation and insulation are practically everlasting, barring accidental breakage; the only item of repair being the wooden frames and glass covers, and it is found that after an installation of glass has once been tested out by the heat, and the badly annealed sheets replaced, the remainder will last for years. This was evidenced by the small 18-by-60-feet heater in operation for three years in Philadelphia. There was a replacement of about ten per cent necessary during the first three weeks; thereafter the heater ran three seasons and only two or three sheets of glass needed replacement, these being accidentally broken.

It is said that there is now being tested out a celluloid-like material having all the necessary properties of glass and being flexible and capable of manufacture in large sheets. The use of this substance will not only greatly reduce the cost of installation for sun-power plants, but will make repairs a factor

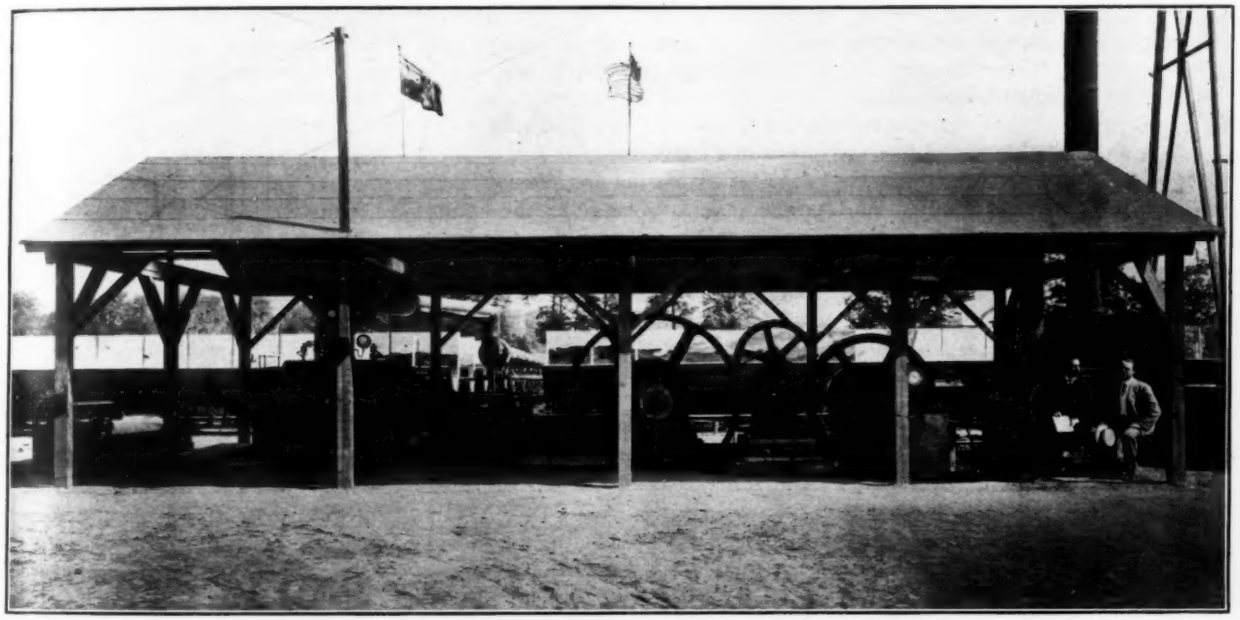


FIG. 1.—SOLAR-HEAT ENGINE, AUXILIARIES AND WATER PUMP.

of but slight importance. The large area covered by the sun-power plant would add greatly to the expense, but inasmuch as these plants are intended for use where the cost of land is very low, such criticism will not hold.

In considering the principle involved and the general construction of the Shuman plant for the generation of mechanical power by the absorption of the sun's rays, it may be of interest to note what has previously been done along these lines. The direct utilization of the natural forces in the development of power suitable for human activities has been for centuries a matter of continued scientific research. Of course, to a limited extent, these forces have been used from the dawn of civilization in the common forms of the windmill and various types of hydraulic turbines and water wheels. It has not, however, been hitherto possible to practically utilize the central dominating force of nature —the sun's heat—in any direct manner, though obviously all power generators are dependent upon this great source for their existence.

Mr. Shuman points out that for many years engineers and physicists have been occupied with this problem; notably John Ericcson, Ferry, Millochan, Mouchat and Tellier in France; Gunther and Althaus in Germany; and Langley and Willsie in America.

It may be stated that these experiments based their efforts either upon the use of lenses or mirrors to concentrate the sun's rays upon a small surface, or upon the heating of fluids of a low boiling point, with subsequent power generation from the vapor under pressure. It has always been attempted to create vapor at high pressure, and then utilize this in the ordinary engine, but with the high temperatures involved, the losses by conduction and convection are so great that the power produced was of no commercial value. Where lenses or mirrors are used, the primary cost of the lenses, and the apparatus necessary to continuously present them toward the sun, have rendered them impracticable.

It is held that where fluids of low boiling point, such as ether, sulphurous acid, and liquid ammonia, were used, the results were of little value by reason of the inherent inefficiency of these fluids as power generators.

It is clear that a sun-power plant, in order to be practicable, must possess high efficiency, low cost of installation and maintenance, well marked length of service; and should not require specially trained mechanics for its operation.

To be efficient, it is not necessary that the plant generate continuously, inasmuch as the great value of such a plant lies in its use as an irrigation apparatus; it is only necessary that the plant run about eight hours daily. It must, however, consist of units which may be assembled to produce a power plant of any required size, the larger the plant the greater the efficiency. It is entirely practicable to produce a sun-power plant in this manner up to 10,000 horsepower and over. An ideal plant must be subject to little accident; hence, it must lie near the ground in order not to be affected by storms and winds. Each unit must be repairable without stopping the operation; construction must be simple and easily understood by the ordinary steam engineer; and wear and tear must be reduced to a minimum.

It is true that the first cost of a sun-power plant, to be practical and of commercial value, must be sufficiently low so that the interest on the investment does not make it unprofitable. This is the rock on which, thus far, all sun-power propositions were wrecked. It is not necessary that the cost of the sun-heat absorber shall be as low as that of a steam boiler and fitting of the same power. The cost of the plant described herein is twice that of the ordinary steam-power plant of the same size. This price is sufficiently low, however, so that even if the extra interest is taken into consideration, the fact that after installation no fuel is required, is such an enormous advantage as to entirely offset the increased cost, and in addition cause great profits.

A decade ago Frank Shuman became interested in the problem of obtaining power by absorbing the sun's rays. It was found, by experiment, that if a vessel were so arranged that the sun's rays could impinge upon it, and if all heat losses by conduction, convection and radiation were prevented by a theoretically perfect method of insulation, the temperature within the vessel would rise certainly to a thousand degrees Fahrenheit, without any attempt being made to concentrate the rays of the sun. For commercial purposes it is impossible to secure any form of insulation which would even approach the theoretical. Commercially, the main object is to produce practical power at a minimum cost, and this has been done by the use of well known and cheap forms of heat insulation.

It is said that were no steam made in these vessels, as they are arranged in the present plant, the temperature therein would go up to 350 degrees Fahrenheit in latitude forty degrees north, possibly to 450 degrees Fahrenheit near the equator. The production of steam at atmospheric pressure, however, keeps the temperature in the vessels down to 212 degrees; and whatever excess of heat is produced by the sun's rays over and above that lost, is converted into steam, and may therefore be utilized.

It is maintained that the experience of additional years will lead to designs considerably better than this first attempt on a commercial scale. Sun power must go through the same long and gradual course of development that has brought other forms of mechanical power to the present high plane of efficiency, but the principle will remain fundamentally correct.

The first Shuman sun-power generator consisted of a wooden box covered by two layers of glass between which was a small air space, and in the box was placed a miniature ether boiler. This apparatus was exposed to the sun's rays, the ether distilled, and the amount of heat which might be absorbed was determined. As an experiment, a small toy engine was successfully run with this original apparatus. A second generator consisted of a two-inch steam pipe, sixteen feet long, insulated at the bottom, and inclosed in a box covered by a double layer of glass. Here again ether was distilled, and the number of heat units absorbed were determined. A third type of power plant was composed of a bed of water pipes properly insulated against heat loss, the unit being 18 by 60 feet, and the motor being an ether engine. With this apparatus 3.5 horsepower was obtained. With the knowledge so gained, the present generator, to be described below, was gradually evolved.

The new sun-power plant consists of the absorber, a low-pressure steam engine, condenser, and auxiliaries. The absorber is composed of a series of units, each containing a flat, metal, honeycomb water vessel, rectangular in shape, and resembling closely a large waffle. This vessel is inclosed in a flat wooden box covered with two layers of

glass having a one-inch air space between them, and having the under surface of the box insulated against heat loss downward by a two-inch layer of regranulated cork and two layers of waterproofed cardboard.

It will be seen from the photograph that the boxes are mounted on supports which elevate them some thirty inches above the ground, and which permit them to be inclined normal to the sun's rays at the meridian. These adjustments of the inclination need only be made about once in three weeks.

There are plane mirrors of cheap construction mounted on two sides of the boxes in order that more rays of the sun may be absorbed and reflected upon the surface of the water vessel. This latter is connected at one end to a feed pipe from the water supply, and at the other end to a steam pipe. The steam pipes from the various units are connected together and empty into a main eight inches in diameter, which conveys the steam to the engine.

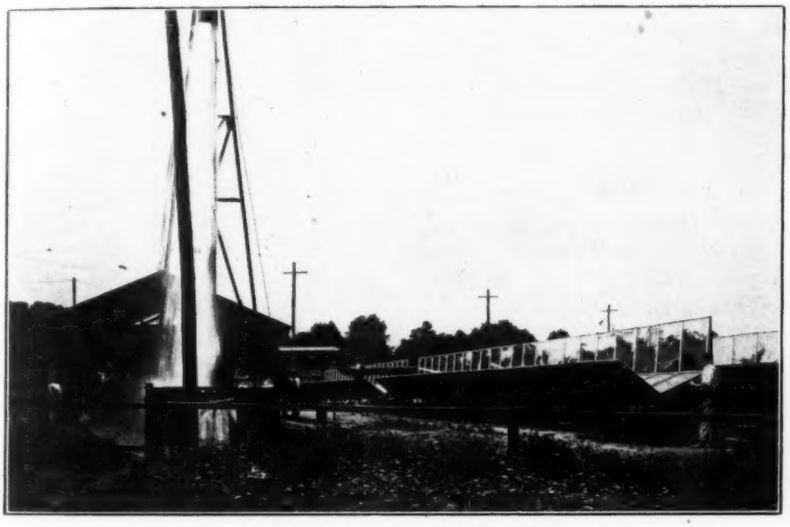


FIG. 2.—SUN-POWER PLANT IN ACTION.

The photograph also shows the engine, which is a low-pressure, reciprocating steam motor of great steam economy. Connected with it is a condenser and auxiliaries such as may be found in any condensing plant. The water from the condenser is pumped back into the absorber, thus insuring a continuous closed circuit, whose only water loss is from accidental leakage, which is carefully guarded against.

It may be mentioned that the power of this first plant is used for pumping water by means of a reciprocating steam pump of the ordinary type, and whenever the sun has shone, during the past six weeks, this plant has pumped water successfully and practically. The capacity of the present plant, in this latitude, is 3,000 gallons of water per minute, lifted to a height of 33 feet.

It is claimed that, from actual tests made in August, 1911, in Philadelphia, it was found that from the absorber of 26 banks of units, each containing 22 single units and having a light-absorptive area of 10,296 square feet and an actual area of 5,148 square feet, there could be developed during eight hours 4,825 pounds of steam. The power produced was much lower than normal to the plant, as it was built for tropical use and was entirely unfitted for commercial work in northern latitudes.

The steam generated in a sun-power plant is reduced largely by humidity and the presence in the air of smoke and haze. It follows, then, that the efficiency will be greatly increased when the apparatus is tested in a dry climate free from atmospheric impurities attendant upon proximity to a large city. The plant was set up at Philadelphia not because it was considered to be a commercial thing there, but because the necessary experimenting with a new plant thousands of miles from home would have been exceedingly expensive. This plant was designed to be erected in Egypt and this can be conveniently done, as the entire heat absorber is practically portable. The losses of heat by conduction and convection in northern latitudes are enormous. If the present apparatus is placed in an average air temperature of 100 degrees Fahrenheit, such as obtain throughout all equatorial regions, it is safe to assume that the power will be multiplied threefold.

The great chance for sun power is in those regions in the tropics where the sun shines throughout the year, and fuel is very expensive. There is room now for at least half a million horsepower in such tropical fields as the nitrate district of Chile; the borax industry in Death Valley, and for general purposes in places where the outside temperature runs from 110 to 140 degrees.

It is claimed that as an irrigation engine there is no limit to the amount of power that can be practically utilized; and for this purpose the conditions need not be so very favorable as those mentioned above. Throughout most of the tropical regions sun power will prove very profitable in irrigation. One advantage of the sun power or, in fact, of any condensing plant for irrigating purposes, is that the water used for the condenser costs nothing, and the main output of the engine can be passed through the condenser first before entering the irrigating canals.

It is pointed out that the interior of Australia, at one time a fertile country, as is evidenced by the fossilized trees, is an area of some 600 miles in each direction which is entirely valueless. During a drouth there have been times when one-third of the sheep raised on the margins of this desert died from thirst, causing great financial loss. In this locality the sun shines with an intensity sufficient to produce an average daily temperature of 100 to 140 degrees.

It is said that the occasional rains nourish the sparse vegetation necessary for sheep, which are watered from wells driven in the ground and pumped, generally by horsepower, very often by hand, and sometimes by means of fuel oil, which, by the time it reaches its destination, brings the coal equivalent up to about $20 per ton.

It is maintained that by building sun engines in this region, and pumping from the always-present underground water, which in this region lies at a depth of from 15 to 40 feet, this country can be made productive and valuable also. Throughout Eastern India and Ceylon many thousands of square miles of farm land can be improved threefold by mechanical irrigation; here hand pumping is mainly the present form of irrigation used and sun power could be utilized to great advantage.

POISONOUS AUTOMOBILE EXHAUSTS.

A POTENT ARGUMENT FOR THE ELECTRIC VEHICLE.

When the tooting of horns on Halloween Eve or on New Year's Eve rends the air with an imitation of chaos, few adults enjoy the boisterous noises unless they are among the hilarious ones themselves. However, almost every one is ready to forgive a disturbance of the usual reign of peace and quiet on such special occasions. But if the same boisterousness were tried at ordinary times, it would probably lead the tooters to a fine for disorderly conduct. Most sane people object to unearthly noises of this kind at ordinary times, just as they do to the firing of blank cartridges, and yet an equally hideous equivalent has lately been forced upon them by the noisy and explosive exhaust of automobiles. In some of the more refined communities, steps have already been taken towards throttling the muffler-cutout nuisance and in time this movement will undoubtedly spread so as to reduce the amount of these unwarranted and avoidable street noises.

But there is another and much more subtle way in which the gasoline automobiles have been making themselves objectionable and one which in its way may be even more serious than their nerve-racking noise. It consists of the air pollution due to the exhaust from the automobile, an exhaust usually directed so that it will mix with the air breathed by pedestrians as well as those driving behind the machine producing the same. With the rapid spread of automobiling, the amount of air vitiation due to this cause has ceased to be negligible and prominent medical journals as well as hygienic investigators have taken up the question of the resulting air pollution. The problem is a complex one owing to the variation in the gases as exhausted, which not only comprise the products of a normal combustion but are usually intermingled with more obnoxious gases not fit for breathing purposes. The smell commonly pervading the air behind a gasoline automobile proves the presence of some of these unhealthy vapors, though it cannot give a clew to what is mixed with the same.

Although the medical fraternity as a whole has paid but little attention to the deleterious action of automobile exhausts, many cases of illness directly traceable to the same have been reported and as far back as 1907 the International Hygienic Congress, then in session at Berlin, recognized the gasoline vapors of automobiles as health-damaging factors. In London, policemen stationed at street crossings have been laid up with clear cases of carbon-monoxide poisoning, while at Vienna a physician recognized a depressive action on his heart and nerves as due to the slow poisoning from the fumes breathed by him while on the street. In 1907 the *London Lancet*, probably the highest recognized authority on medical topics, in an article on "Motor Traffic and the Pollution of the Air,"[1] pointed out that the imperfect combustion of gasoline in a motor caused not only a visible and nasally distinguishable smoke, but also large quantities of carbonic oxides and acetylene, which latter could produce a feeling of partial unconsciousness akin to that due to narcotics.

Recently, Dr. Arthur Korff-Petersen of the Hygienic Institute connected with the Royal University at Berlin has made a study of the exhaust gases of gasoline automobiles. He found that the visible part of the exhaust, which is usually noticed as a bluish-gray cloud, consists of water vapor (a normal combustion product of the gasoline) mixed with considerable soot, the amount of the latter determining the color of the exhaust vapor. This soot in itself is a nuisance, but not nearly as important as the invisible portions of the exhaust gases. On analyzing the latter, Dr. Korff-Petersen found them to contain:

Nitrogen	85.0 per cent
Carbon dioxide	4.9 per cent
Oxygen	5.3 per cent
Carbon monoxide	3.7 per cent

The other 1.1 per cent consisted of methane, some heavy carbohydrates, hydrogen and some undetermined gases of the nature of aldehydes. The latter usually have very unpleasant odors (as in the case of the familiar fusel oil which taints cheap whiskey), and the obnoxiousness of the exhaust seems to owe much to their presence. The amount of the poisonous carbon monoxide found in these tests, which were made on automobiles at both low and high speeds and with various grades of gasoline, is much less than that previously reported by Clerk in the *Horseless Age*. The latter had found that in many cases the proportion of carbon monoxide in the exhaust of moving automobiles ran as high as seven per cent.

To test the poisonous action of these exhausts, the Berlin investigator filled a glass with the same. A mouse placed in the glass was seized with cramps and died in less than a minute. On repeating the tests with the exhausts diluted with air, the same symptoms of poisoning appeared but vanished gradually if the mice were taken into fresh air in time. By passing the gases over an absorbent which would remove the carbon monoxide, they lost so much of their toxic action that a mouse placed in the same was still alive after three quarters of an hour, though showing symptoms of poisoning. In as much as so small a proportion of carbon monoxide in air as one part in 2,000 has a poisonous action on the human system, it is easy to see that this can be attained where traffic is congested or where a number of automobiles are standing still with their engines running. Indeed, it may even be possible in the case of motor buses where part of the exhaust penetrates the interior of the car.

Experiments on mice subjected only to the odorous part of the exhaust produced great discomfort and irritation in them, but did not prove sufficient for killing them. However, Dr. Korff-Petersen found that these malodorous gases were due almost wholly to the lubricating oils used in the engines. Indeed, he was able practically to duplicate the same by passing air through lubricating oil heated to about 572 degrees Fahrenheit—a temperature less than half of that prevailing in the engines. By leading the resulting vapor through water he produced the peculiar

[1] In view of the evident lack of improvement in the conditions to which this editorial called attention, some extracts from the same deserve to be quoted: "Not only does the motor engine at times give off offensive fumes which are easily visible, but it also discharges unseen gases which, though apparently inoffensive, are decidedly poisonous. Perfect combustion is hardly ever attained and amongst the products of incomplete combustion are two deadly gases—carbon monoxide and acetylene. * * * The chauffeur who, through bad engineering, allows his motor to evolve a maximum volume of these gases for each explosion in the engine is just as much a sinner against hygienic demands as is the manufacturer who makes the air vile with filthy black smoke. * * * Now that the streets of London are crowded with motor vehicles, the outpouring of poisonous carbon monoxide must be considerable. It is to be hoped that this pollution will spare the pedestrians from those symptoms of carbon-monoxide poisoning which are so well recognized in the poor collier who has been fortunate enough to escape the direct effects of the colliery explosion, but who has been compelled to breathe the treacherous after-damp. Even small quantities of carbon monoxide in the air produce a serious disturbance of the health standard, the leading symptoms being headache, loss of power in the limbs, and a state of semi-consciousness as though a narcotic had been taken. In stagnant weather it would not be surprising to find that such symptoms had their origin in the outpourings of motor traffic, and we may next have to consider the question of ventilating the streets."

aldehyde which he had found in the motor exhausts.

Whether the gradual improvements in internal-combustion engines and in carbureters for the same will involve a purifying of the exhaust gases, remains to be seen. Judging from the development so far attained, not much is to be expected along this line in the immediate future and in the meantime the average automobile is polluting the air in our streets at a rate that is appalling. Just to what extent the motorists are undermining their own health by breathing these exhausts, is hard to estimate. However, there is a satisfaction in knowing that one class of automobile—the same one that is free from the nerve-racking tremor, the sudden explosive noises and the boosting of insurance rates—is faultless in its influence on the air. In cities where the municipal authorities really have the welfare of the community at heart, they may grow aware of this distinction in time; and when they do so, they will be well warranted both in exempting the quiet-running, non-exhausting electrics from taxation and in doubling the fee for every automobile that emits a malodorous puff.

The Effective Capacity of High-Tension Cables.

At the meeting of the American Physical Society held in Chicago on December 2, a paper was presented by G. W. Stewart and D. M. Terwilliger entitled, "A Method of Measuring the Effective Capacity of High-Tension Cables."

The paper dealt with a three-phase cable which was measured in a length of less than fifty centimeters, using the method of dividing the charge with an electrometer and utilizing the relation of the partial capacities of the different conductors to the whole. Although the manufacturers of the cable had found by the ballistic-galvanometer method a temperature variation of from ten to fifty per cent between sixty and eighty degrees Fahrenheit, the writer found no perceptible variation of capacity within these limits.

Nearly 150,000 Oil Wells in Operation.

There are now 148,440 oil wells in operation in the United States. They average about four barrels a day, but in Pennsylvania and New York old wells in some districts yield a profit on less than one-fifth of a barrel a day.

A Television Idea.

In the course of his presidential address to the Röntgen Society, as outlined in the London *Times*, A. A. Campbell Swinton outlined an arrangement by which with the aid of cathode rays it might be possible to realize distant electrical vision.

The transmitter, as mentioned for this scheme, consisted of a Crookes tube fitted with a cathode which sent a cathode-ray discharge through a small aperture in the anode, the cathode rays being produced by a battery or other source of continuous electric current giving some 100,000 volts. Two electromagnets were placed at right angles to one another, in such a way that when energized by alternating current, they would deflect the cathode rays in a vertical and in a horizontal direction respectively.

The receiving apparatus consisted similarly of a Crookes tube fitted with a cathode, which transmitted cathode rays through an aperture in the anode. Again there were two electromagnets placed at right angles, similar to those in the transmitter; the two magnets (in the transmitter and receiver) which controlled the vertical motions of the cathode-ray beam were energized from the same alternating dynamo, which had a frequency, say, of ten complete alternations per second, while the other two magnets which controlled the horizontal movements of the cathode-ray beam, were energized by a second alternating dynamo having a frequency of, say, 1,000 complete alternations per second.

In the receiver was a fluorescent screen upon which the cathode rays impinged, and the whole surface of which they searched out every tenth of a second under the combined deflecting influence of the two magnets, with the result that the screen fluoresced with what appeared to the eye as a uniform brilliancy. Similarly, in the transmitting apparatus, the cathode rays fell on a screen, the whole surface of which they searched out every tenth of a second under the influence of the magnets. Further, as the two pairs of magnets were energized by the same currents, the movements of the two beams of cathode rays would be exactly synchronous and the cathode rays would always fall on the two screens and on each corresponding spot simultaneously.

In the transmitter, the screen, which was gas-tight, was formed of a number of small metallic cubes insulated from one another, but presenting a clean metallic surface to the cathode rays on the one side, and to a suitable gas or vapor, say sodium vapor, on the other. The metallic cubes which composed this screen were made of some metal, such as rubidium, which was strongly active photo-electrically in discharging negative electricity under the influence of light, while the receptacle behind it was filled with a gas or vapor, such as sodium vapor, which conducted negative electricity more readily under the influence of light than in the dark. Parallel to the screen was another screen of metallic gauze, and the image of the object which was to be transmitted was projected by lens through the gauze screen upon the photo-electric screen through the vapor contained in the receptacle. The gauze screen was connected through the line wire to a metallic plate in the receiver, past which the cathode rays had to pass. There was in the receiver a diaphragm fitted with an aperture in such a position as, having regard to the inclined position of the cathode, to cut off the cathode rays coming from the latter and prevent them from reaching the fluorescent screen unless they were slightly repelled from the metallic plate, when they were able to pass through the aperture.

The whole apparatus was designed by the author of the paper to operate as follows.

Assuming a uniform beam of cathode rays to be passing in the two Crookes tubes in the transmitter and receiver, and the two pairs of magnets to be energized with alternating current, as mentioned, and assuming that the image to be transmitted was strongly projected through the lens and gauze screen upon the photo-electric screen; then, as the cathode rays in the sending Crookes tube oscillated and searched out the surface of that screen, they would impart a negative charge in turn to all the metallic cubes of which it was composed. In the case of cubes on which no light was projected, nothing further would happen, the charge dissipating itself in the tube; but in the case of such of the cubes as were brightly illuminated by the projected image, the negative charge imparted to them by the cathode rays would pass away through the ionized gas along the line of the illuminating

beam of light until it reached the gauze screen, whence the charge would travel by means of the line wire to the metallic plate of the receiver. This plate would thereby be charged; would slightly repel the cathode rays in the receiver; would enable these rays to pass through the diaphragm, and, impinging on the fluorescent screen, would make a spot of light. This would occur in the case of each metallic cube of the transmitting screen which was illuminated, while each bright spot on the fluorescent screen would have relatively exactly the same position as that of each illuminated cube. Consequently, as the cathode ray beam in the transmitter passed over in turn each of the metallic cubes of the screen, it would indicate by a corresponding bright spot on the fluorescent screen whether any particular cube was or was not illuminated, with the result that the fluorescent screen, within one-tenth of a second, would be covered with a number of luminous spots exactly corresponding to the luminous image thrown on the transmitting screen, to the extent that this image could be reconstructed in a mosaic fashion. By making the beams of cathode rays very thin and employing a very large number of very small metallic cubes, and a high rate of alternation in the dynamo, it is obvious that the size of the luminous spots by which the image was constituted could be made very small and numerous, with the result that the more these conditions were observed the more distinct and accurate would be the received image.

It is also obvious that, by employing for the fluorescent material something that had some degree of persistency in its fluorescence, it would be possible to reduce the rate at which the synchronized motions and impulses need take place, though this would only be attained at the expense of being able to follow rapid movements in the image that was being transmitted. Further, as each of the metallic cubes acts as an independent photo-electric cell, and is called upon to act only once in a tenth of a second, the arrangement has obvious advantages over the other arrangements that had been suggested, in which a single photo-electric cell was called upon to produce the many thousands of separate impulses required to be transmitted through the line wire each second, a condition which no known form of photo-electric cell would admit of. Nor does sluggishness on the part of the metallic cubes or of the vapor in the receptacle in acting photo-electrically interfere with the correct transmission and reproduction of the image, provided all portions of the image are at rest; and it is only to the extent that portions of the image might be in motion that such sluggishness could have any prejudicial effect. In fact, sluggishness would only cause changes in the image to appear gradually instead of instantaneously.

The World's Production of Coal.

The total coal production of the world in 1910 was approximately 1,300,000,000 short tons, of which the United States contributed about thirty-nine per cent. This country has far outstripped all others, and in 1910, according to the United States Geological Survey, it exceeded Great Britain, which ranks second, by over 200,000,000 tons.

The United States has held first place among the coal-producing countries of the world since 1899, when it surpassed Great Britain. In the eleven years since 1899 the annual output of the United States has nearly doubled, from 253,741,192 short tons to 501,596,378 tons, whereas that of Great Britain has increased only twenty per cent, from 246,506,155 short tons to 296,007,699 tons.

The following table shows the coal production of the principal countries of the world in 1910, except those for which only the 1909 figures are available:

THE WORLD'S PRODUCTION OF COAL.

	Short Tons.
United States (1910)	501,596,378
Great Britain (1910)	296,007,699
Germany (1910)	245,043,120
Austria-Hungary (1909)	54,573,788
France (1910)	42,516,232
Belgium (1910)	26,374,986
Russia and Finland (1910)	24,967,095
Japan (1909)	16,505,418
Canada (1910)	12,796,512
China (1909)	13,227,600
India (1909)	13,294,528
New South Wales (1909)	7,862,264
Spain (1909)	4,546,713
Transvaal (1910)	4,446,477
Natal (1910)	2,572,012
New Zealand (1909)	2,140,597
Mexico (1909)	1,432,990
Holland (1909)	1,235,515
Queensland and Victoria	1,119,708
Italy (1909)	611,857
Sweden (1909)	272,056
Cape Colony (1909)	103,519
Tasmania (1909)	93,845
Other countries	5,236,903
Total	1,278,577,812

Largest Output of Petroleum Ever Reported.

More than 200,000,000 barrels of oil, with a value of nearly $128,000,000 were produced in the United States last year.

LOS ANGELES ELECTRICAL SHOW.

FIRST ELECTRICAL EXPOSITION A SUCCESS.

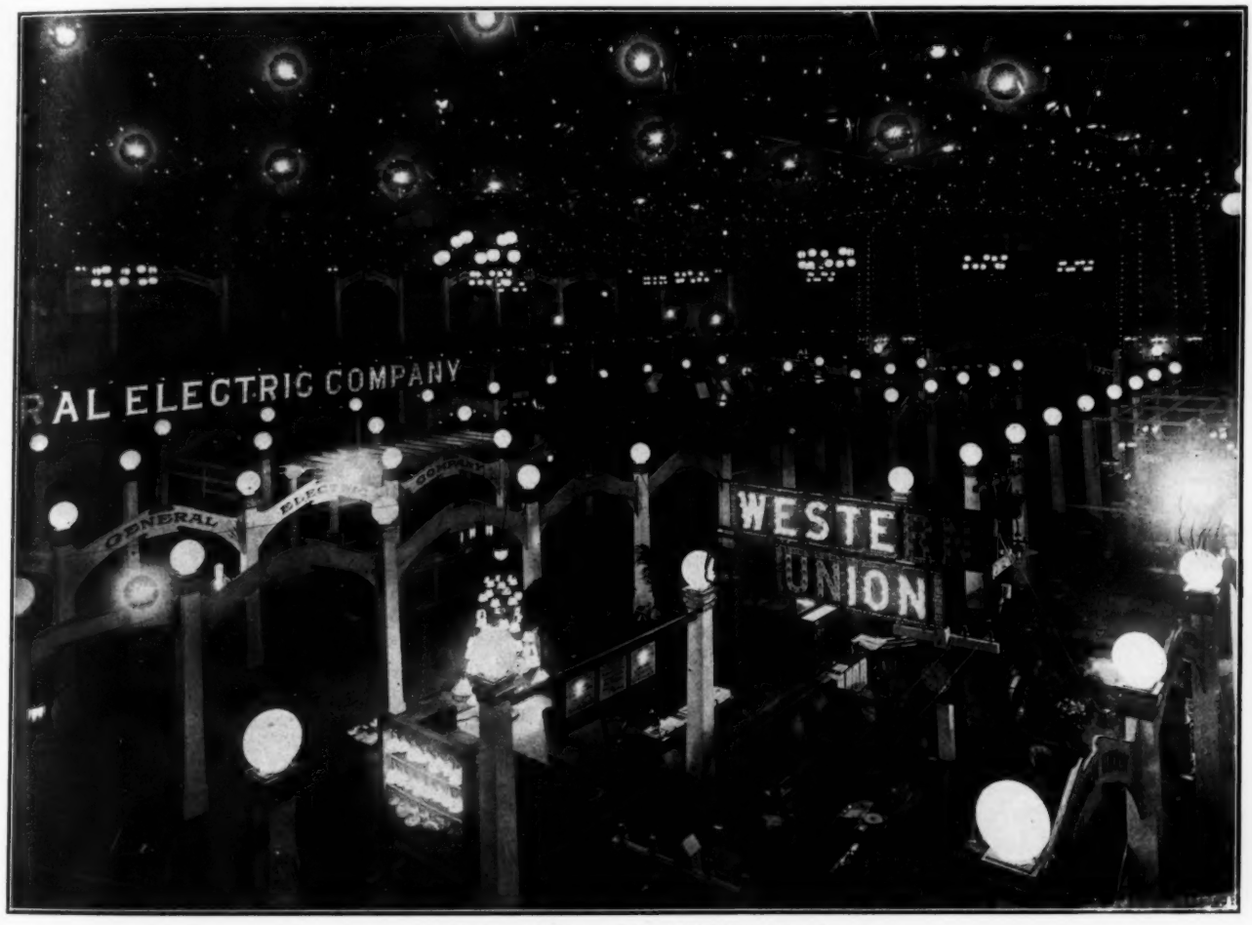
The first electrical show ever held in Los Angeles, Cal., was opened November 25, to continue daily, from 2 to 11 p. m., including Sundays, until December 9. The show, while originally planned at Fiesta Park, is held at the Shrine Auditorium, which offers many advantages to the display. The exhibitors, numbering close to fifty, completely fill the main floor and balcony, which aggregate a floor area of approximately 50,000 square feet. A suspended band stand in the center of the hall is occupied by the Catalina Band offering selected concert numbers day and evening. The show has been well advertised throughout California, Nevada and Arizona, and the attendance is large. The railroad companies have offered special reduced round-trip rates from many inland points, and the local Los Angeles Railway Company operates special cars to the display in the early hours of the evening.

The exhibition is given under the direction of the Los Angeles Electrical Exposition, an organization of local electrical interests, upon a general profit-sharing plan. The net profits will be divided among the different exhibitors pro rata to the amount of floor space occupied. The full return for each exhibitor for cost of exhibit space is practically assured, according to the management. The Executive Committee is composed of H. B. Woodill, chairman; C. S. Walton, vice-chairman; J. E. MacDonald, T. E. Burger, C. G. Pyle, L. O. Lieber, W. B. Palmer and D. M. Moses, general manager. Excepting the manager, the services of the entire Committee were rendered gratis. Other committees were in charge of decorations and illumination, transportation, entertainment, etc.

Special days were set aside to entertain the children of the local orphan asylums, to allow all school children to visit the show at half-price, regardless of age, and for the students of Throop Polytechnic Institute, Pasadena. December 4 was given over to the Merchants' and Manufacturers' Association of Los Angeles. Guessing contests and other forms of prize-offering entertainment were established to interest the general public.

The scheme of decoration and lighting is uniform and pleasing. All spectacular display has been eliminated to provide for a regular and systematic arrangement. The iron roof trusses are trimmed along the bottom members with strings of Christmas evergreen, and at intervals of approximately five feet, sixteen-candlepower lamps are hung. These are of green color to match the draping. The ceiling lighting includes twenty-eight crystal chandeliers, each bearing ten lamps, and seventy-two arc lamps. Around the balcony and stage of the auditorium sixteen-candlepower lamps are arranged at regular intervals. Of this capacity lamp, in the overhead lighting noted, there are a total of about 2,500 lamps.

Upon the main floor the illumination consists of fifty 500-watt, fifty 250-watt and 170 100-watt lamps. Columns, surmounted with white frosted globes, are spaced at intervals of about ten feet to serve for the booth framing along the aisles and between the center rows of the booths. Facing the aisles, the construction between the columns is of a slight arch nature, of sufficient width to permit the name of the exhibitor to be stamped in large letters. The decoration throughout is white, the display names being marked in blue with gold shading outline. Many of the exhibitors displayed electric name signs, which, as well as the lighting and general arrangement noted, is shown in the accompanying photograph. The booths were arranged at all sides of the hall, with two rows through the center and middle aisle between.



GENERAL VIEW OF LOS ANGELES SHOW.

The electric energy for the lighting, as well as the direct-current required for various exhibits, was furnished by the Southern California Edison Company. The Los Angeles Gas & Electric Company supplied 15,000-volt current for some of the features and spectacular exhibits.

The public-service companies, including the Southern California Edison Company, the Pacific Electric Railway Company, the Home Telephone Company and the Western Union Telegraph Company, each had attractive exhibits to interest, as well as educate, the general public.

The Southern California Edison Company explained the method of reading meters by means of five large dial faces and hands, with an attendant to mark the reading in kilowatt-hours upon the shifting of any position of the hands. A meter-testing outfit was exhibited and explained; a General Electric Company mercury-arc rectifier, with auxiliaries, was shown. The company had a motor-generator set in operation for furnishing electric energy for the various motors of the different exhibitors. C. S. Walton, G. E. Simpson, and others represented the company.

The Pacific Electric Railway Company arranged a reproduction of one of its standard cars, the interior of which, formed by a platform in the auditorium, was arranged for a free moving-picture display. This also took the form of illustrated lectures, explaining scenes along the route, the growth of the system, service afforded

the public, etc. The entire display was arranged by E. C. Thomas, advertising agent for the company, and who was in charge at the show, with a force of assistants.

The Western Union Telegraph Company displayed its typewriter-telegraph system, and demonstrated the operation from the taking of messages to receiving at a distant office. The company also showed its duplex and quadruplex apparatus, and a few of the instruments now obsolete. The display was ably handled by F. A. Bennett, commercial agent, and G. E. Palmer, district equipment supervisor of the company.

The Home Telephone Company installed a regular panel exchange board for single operator and a telephone booth for the convenience of visitors. An operator was placed in charge.

Spectacular performances were given by W. B. Palmer, using a Tesla high-frequency apparatus. This includes many familiar "freaks" to the electrical man, but very attractive to the general public, such as lighting incandescent lamps while holding in the hand, etc. Mr. Palmer subjected himself to a "named voltage" of 400,000 while sitting in a chair, which was a reproduction of an electric chair, with similar contrivances.

A like spectacular exhibit was given by E. J. Rose with a forty-four-inch Tesla high-frequency and a thirty-inch Oudin high-frequency outfit.

Four exhibits furnished by the United States government proved highly educational and instructive. The departments represented were the Bureau of Standards, the Weather Bureau, the Navy and the Smithsonian Institute.

The Bureau of Standards, in charge of Frank A. Wolff, exhibited numerous standard electrical measuring instruments, standards of weights and measures and capacities, a potentiometer for calibrating measuring instruments, and similar apparatus.

The Weather Bureau, in charge of A. B. Wollaber, head of the Los Angeles district, displayed meteorological instruments used in the department for showing extent of sunshine, temperature rating, distance and velocity of the wind, rainfall, and the like. Marine meteorological charts, photographs of atmospheric conditions, and storm flag signals are shown.

The Navy Department, in charge of J. A. Aulbach, J. J. Dowd, and others, presented its standard wireless-telegraph apparatus complete.

The exhibit of the Smithsonian Institute, showing models of former electrical patents, is interesting both to the electrical man, student and general public. The display presents many items dating from Joseph Henry's electro-magnetic reciprocating apparatus (1831), to the William Wallace electric-light dynamo (1873) and arc lamp (1875).

Other educational and instructive exhibits were shown by the Shredded Wheat Company and Globe Mills of Los Angeles, demonstrating the part that electric energy takes in the production of food materials; by the Los Angeles Creamery Company, with the Burrell - Lawrence - Kennedy electric cow-milking machine, and by the Los Angeles Silk Company, which exhibited an electrically driven silk-weaving machine.

Among the exhibitors were the following manufacturers and dealers in electrical apparatus:

American Multigraph Sales Company, Cleveland, showing the Gammeter multigraph. O. C. Haney, Los Angeles sales manager, is in charge.

Baker-Chase Electric Company, Los Angeles, exhibiting electric-lighting fixtures, electric heating appliances. E. W. Chase is in charge.

Bell & Jamison, Los Angeles, demonstrating the electric-weld rail-bonding machine of the Electric Railway Improvement Company.

Crocker-Wheeler Company, Ampere, N. J., shows a line of small motors. The exhibit was in charge of W. B. Palmer.

Cutler-Hammer Manufacturing Company, Milwaukee, exhibiting an assortment of its controlling apparatus, electric heating, appliances, etc. W. B. Palmer was in charge.

Dictaphone Company, Columbia Phonograph Company, New York, showing the dictaphone. The Southwest Sales Company, Los Angeles, is in attendance.

Duntley Manufacturing Company, Chicago, demonstrating its well known vacuum cleaning apparatus. F. G. Kingston & Company, local representatives, are in attendance.

Empire Electric Company, Los Angeles and Chicago, exhibiting X-Ray apparatus, both portable and instantaneous, high-frequency equipment, etc. E. J. Rose, inventor for the company, is in charge.

J. C. Farrar & Company, Los Angeles, shows a line of interior power-plant equipment, insulators, and Ohio Blower Company specialties. Mr. Farrar is in attendance.

Gans Brothers, Los Angeles, electrical contractors and dealers, exhibits a line of electric household appliances, washing and wringing machines. Messrs. Gans Brothers in attendance.

General Electric Company, Schenectady, N. Y., shows a complete line of its small electrical apparatus, such as motors, controllers, switches, etc., and a full assortment of electric heating devices and electric household appliances. The Los Angeles office force, under the direction of J. O. Case represents the company. The company has an attractive feature in the operation of a three-phase motor under water in a glass-inclosed case.

Haskins Glass Company, Wheeling, W. Va., shows a large assortment of shades and globes. R. H. Wallace, manager, represents the company.

Kellogg Switchboard & Supply Company, Chicago, presents its wall and portable telephone instruments and the Delco ignition apparatus. C. F. Hartung is in charge.

Kelman Electric & Manufacturing Company, Los Angeles, exhibits its oil switches and specialties. Mr. Kelman is in charge.

B. F. Kieruiff, Jr. & Company, Los Angeles, shows a line of Fort Wayne Electric Works transformers, Sprague Electric Company motors, and General Incandescent Lamp Company lamps, together with cables, wires and similar specialties.

Los Angeles Brass Company, exhibiting its brass electric lighting fixtures, and brass products. L. Swarts represents the company.

Luitwieler Pumping Engine Company, Rochester, N. Y., showing its deep-well pumping machine in charge of the Los Angeles branch.

The National Electric Lamp Association exhibited the "Holophane tree," a large tree-shaped fixture finished in statuary bronze on which are shown Mazda-Holophane units of six different sizes, the whole being surmounted by a 500-watt lamp. The circuits are controlled by a flasher which lights the different tiers of lamps successively. A great variety of miniature and low-voltage lamps with drawn-wire filaments are shown in a glass case, while lamps designed for automobile use are displayed in modern headlights, side lights, etc. A full line of multiple lamps is on exhibition in a case lighted with Mazda five-watt sign lamps. The floral decorations of the booth are supplemented by decorative lamps in the shapes of flowers, fruits, animals, etc., especially suited for Christmas tree lighting. The exhibit is in charge of F. J. Blaschke. G. C. Webster, manager of the Engineering Department is also in attendance at the booth.

John A. Roebling's Sons Company, Trenton, N. J., exhibits a complete line of cables, wires, etc. L. W. Drake of Los Angeles branch office in attendance.

Southern California Electric Company, Los Angeles, presents a display of electric heating appliances, electric cooking devices, household equipment and the like.

Standard Electric Time Company, Boston, shows a line of its electric clocks, program clocks, time stamps, etc. J. J. Estabrook, Pacific Coast manager, is in charge.

Standard Underground Cable Company, Pittsburg, exhibits a line of its wires, cables, terminals, etc. C. G. Pyle, Pacific Coast department, is attending.

Tuttle-Stevens Manufacturing Company, Los Angeles, shows an attractive display of electric cooking appliances, and cooking cabinets.

U. S. Electrical Manufacturing Company, Los Angeles, exhibits a line of small motors and similar equipment.

Warner Instrument Company shows an assortment of its electrical measuring instruments.

Woodill & Hulse Electric Company, Los Angeles, presents an attractive exhibit of electrical appliances for household use, such as heaters, cookers, washing and wringing machines, etc., as well as a line of lamps, sockets and similar specialties. A large force of attendants demonstrate. H. B. Woodill is in charge.

Wurlitzer electric organs and pianos are shown by William L. Glockler.

Electric vehicles, both for commercial and pleasure use, are exhibited by Columbus Electric Vehicle Company, Detroit Electric Vehicle Company, Los Angeles Electric Vehicle Company and the Ohio Electric Vehicle Company.

WATER-POWER DEVELOPMENT.

HEARING BEFORE UNITED STATES NATIONAL WATERWAYS COMMISSION.

The difficult and unsatisfactory situation existing at present in regard to the development of water-powers of the United States, some time ago lead the United States National Waterways Commission to set a public hearing for the discussion of water-power questions in Washington on November 21. The American Institute of Electrical Engineers was invited to attend and to contribute to this discussion, as were also a number of other societies and certain individuals prominent in the field of water-power development. The board of directors regarded the acceptance of this invitation as a duty to the members, and on November 10 it passed resolutions to this end.

The president appointed, in addition to the Public Policy Committee, Edward D. Adams, Philip P. Barton, Louis Bell, Dugald C. Jackson, William S. Lee, Lewis B. Stillwell and Percy H. Thomas.

The Public Policy Committee appointed a sub-committee, consisting of Gano Dunn and H. W. Buck, to make a preliminary draft expressing its views, which draft was submitted to a full meeting of the Public Policy Committee and the advisory members, and was modified to conform to and to represent their joint opinion. On November 20 the president of the Institute, the chairman of the Public Policy Committee and Messrs. Townley, Stillwell and Finney went to Washington to represent the Institute at the hearing which, on November 21 and the morning of November 22, was devoted by the Commission to the presentation of the Institute's views and such discussion of them as was brought out by questions of the Commissioners.

President Dunn defined the attitude of the American Institute of Electrical Engineers towards the issues by pointing out to the Commission that the Institute was a scientific and professional body and not commercial; that it refrained from making suggestions or expressing its views on the commercial, political, legal or other aspects of the water-power situation excepting as these were incidental to the questions of electrical engineering involved, and which it brought to the attention of the Commission. He also discussed, under cross-examination by the Commission, the factors determining the rates for water power, the statistics on developed and undeveloped water powers in the United States, and the engineering as distinguished from the commercial advantages of interconnection of contiguous hydroelectric systems.

L. B. Stillwell answered questions of the Commission in regard to distances over which electric transmission was possible, the causes of interruptions to service in hydroelectric systems as compared to the same interruptions in steam-electric systems, and the difficulties in securing capital on account of the large investment required by hydroelectric systems. He also pointed out that the value of a stream as a source of power was usually much greater than its value as a waterway.

Calvert Townley presented to the Commission most convincing views in regard to the difficulties under which hydroelectric systems labored in their early stages from failure of their expected market to develop, and answered many questions of the Commission regarding the development of water powers in New England, and the bearing of steam auxiliaries upon the income of hydroelectric systems.

Mr. Stott, on the second day of the hearing, gave authoritative information on the rates at which the cost of coal had been rising in the last decade and at which the amount of coal consumed per horsepower in steam stations had been falling. He was questioned by the Commission in regard to the control that steam competition exercised over the rates of hydroelectric companies, and on the first cost of investment in steam-electric stations.

Mr. Finney described the interconnections of the plants of the Southern Power Company, and the advantages not only engineering but otherwise that resulted therefrom, and gave important information to the Commission upon the opportunities for the utilization of secondary power of hydroelectric systems for electrochemical purposes. Mr. Finney also answered many questions of the Commission in regard to the general relations of the water-power companies of the South and the statistics on their markets, and other information.

Edward D. Adams submitted views to the Commission in writing upon the economic features of the question.

The Institute delegation left after the morning hearing on November 22; the rest of the hearing was devoted to other societies and to members of the National Electric Light Association.

An abstract of the brief presented by the Institute committee follows.

The function of the American Institute of Electrical Engineers is scientific and professional, and is not commercial; consequently, its committee refrains from expressing itself on the commercial, industrial, legal or political aspects of the water-power situation, except when these are incidental to the effect of that situation upon the practice of electrical engineering which it is the Society's object to promote. It appreciates also that the Commission is probably desirous not of the views of particular individuals, which might represent only individual opinions, but would be glad to have before it such opinions as are shared by a group of experts and may therefore be regarded as representative and out of the field of controversy. It has therefore prepared a statement of such opinions on a number of electrical engineering and closely allied questions related to the development of water powers. The subject is one of vital interest to the American Institute of Electrical Engineers because the whole character of water-power development has been changed from that of a local enterprise to that of a great public-service utility by means which electrical engineers have provided, and the utility and development of water power depends almost entirely upon the fact that it may be transformed into electric power.

RELATION OF WATER POWER TO NAVIGATION.

That the utilization of rivers and smaller streams for navigation and for the development of power are naturally inter-related is obvious. As regards by far the greater part of our undeveloped water powers on the public domain, the ultimate value as sources of power of those streams is vastly greater than any possible value which could be realized by attempts to utilize them as channels for navigation, but in the case of many of our larger rivers the possibilities of development for purposes of navigation predominate as compared with power development. The committee recognizes the fact that in all cases where practical possibilities of both navigation and power development exist the two objects in view are co-operative and not antagonistic—the construction of the dams and locks necessary to secure navigability affording a natural and generally effective means of developing the power of the streams.

WATER POWER A PUBLIC UTILITY.

Modern water-power developments usually are not local private enterprises, as is generally supposed. The developments in recent years in the electrical transmission of power have made possible the distribution of electric power from a single water-power plant over territories embracing in some cases over 40,000 square miles in area, supplying electric power for diversified purposes to hundreds of thousands of people. Such distribution of water power is an advantage to the consumers, and any policy tending to retard or handicap the development of water powers is a disadvantage to the people in the surrounding territory and retards its industrial development. The regulation of public utilities by public-service commissions has become practically an accepted principle in the United States, and there is no reason why safeguard from unfair charges for water power should not be found by this means, especially where the wide area covered by

electrical distribution makes the public nature of a water power obvious.

DISTRIBUTION OF INVESTMENT IN HYDRO-ELECTRIC SYSTEMS.

The investment of capital in hydroelectric systems is not confined to the dam and power house. In general, not over fifty per cent of the investment is represented in the generating plant, the balance representing the cost of the transmission lines radiating from the plant, the substations at the ends of the transmission lines for the conversion and distribution of the transmitted power, and the secondary distribution lines delivering power from the substations to the premises of the various consumers. The distribution system outside of the power plant, while not apparent to the casual observer of a power house and dam, represents in many hydroelectric developments the greater part of the total investment.

COMPETITION BETWEEN WATER AND STEAM POWER.

The belief among certain classes of the public that water powers yield excessive or disproportionate profits springs primarily from two causes—the conception that the water itself is the power and that the expenses of operation of a water power are small while the company's income is large. While, certainly, the power could not be developed without the water, the water on its part can deliver no power except by means of the dam, the power house, and its appurtenances. It is difficult for the public to regard these once built as involving continuing expense, but they do. This expense is comparable in amount with the cost of coal in a steam station, and is the return due to the capital invested. It takes the form of interest, sinking-fund expenditures, depreciation and taxes. The invested capital in a water power is so much greater than the public realizes, that with interest charges at not more than five or six per cent, in a majority of cases, from seventy to eighty per cent of a water-power company's income is absorbed.

Of a water power once built, and after its expected market has been developed, the operating expenses, exclusive of the returns to capital, are seen by the public to be small, which they are, in a majority of cases absorbing only from fifteen to twenty per cent of a company's income. The remainder, however, that is left for profit after capital and operating charges are paid is usually not large and certainly not excessive, especially when there is always risk of damage from floods, lightning, failure of expected market to develop, and such uncertainties of operation as the art of electrical engineering has not yet been able completely to remove. Practically all water powers come to birth or not on the answer to the question, "What is steam power in the territory costing?", and they can only live when they deliver power at a substantially lower cost. At the same cost, they remain unborn. Besides the cost of power, the relative amount of investment is a determining factor. While at present a steam electric plant can be built for $75 per horsepower, the cost of a hydroelectric plant varies from two to four times that amount. Part of this difference is because the steam plant can be built near the center of its market, while the water power is almost invariably at a distance. Attention is often called to the increasing cost of coal with an implication that the cost of steam power will rise, permitting hydroelectric companies to raise their rates and exact undue profits. The implication is not correct. It is true that the cost of coal is rising, but it is also true that steam engines and boilers are constantly being improved in efficiency, and that the art of producing power from steam is progressing at a rate so much more rapid than that at which the price of coal is rising that the cost of steam power is continually falling. Gas and oil engines are making such constant reductions in the cost of power that there is no probability that water powers will be free from the controlling competition of other kinds of prime movers.

CONSTRUCTION RISK IN HYDROELECTRIC DEVELOPMENT.

While hydroelectric engineering is tending toward more standard methods of construction, each individual development will present new problems in engineering with the inevitable construction risk connected therewith. During construction the works are constantly subject to serious damage by abnormal floods, and unexpected difficulties and physical conditions may arise whereby the cost of construction may be very materially increased beyond original expectations. Furthermore, after the power plant itself is satisfactorily completed, the success of the enterprise is commonly dependent upon the industrial development of a large territory surrounding the power plant upon which it relies for its market for power. On account of these engineering and operating risks and uncertainties capital which is invested in hydroelectric enterprises is entitled to commensurate reward.

REVOCABLE OR LIMITED-TERM PERMIT.

The revocable permit for the construction of a hydroelectric system does not attract capital because of the obvious uncertainties involved. In case of revocation, not only would the power plant and dam be forfeited, but all of the transmission lines, substations, and distribution system dependent thereon for their operation jeopardized. It is also very difficult to close the long-term power contracts with consumers which are necessary to make a hydroelectric system financially successful. Consumers are unwilling to make their future business requiring power dependent upon a permit which might cause at any time the complete disorganization of the system supplying their power. A limited-term franchise also involves financial and engineering difficulties which seriously impede the normal development of a progressive hydroelectric system. Such systems are laid out from their inception for ultimate growth, and in this respect are comparable to large railway systems. With a limited definite term beyond which renewal of rights are uncertain, no company would be willing to continue indefinitely the extension and improvement of a system so necessary and desirable from the standpoint of public service. Maintenance expenses would be cut to a minimum, and the plant would deteriorate to a point where the service to the public would become unsatisfactory.

INTERCONNECTION OF CONTIGUOUS HYDRO-ELECTRIC SYSTEMS.

It has been suggested that with the growth in extent of large hydroelectric distributing systems ultimate interconnections and combinations between them might establish a monopoly and permit the raising of prices for power. Such interconnection between contiguous hydroelectric systems offers decided and important engineering advantages. Such interconnection also permits reduction in operating expenses and assures better service by reducing to a minimum the probability of total interruptions.

The investment and consequently the cost of power can be reduced by combination, because less capacity in generating machinery to serve as spare plant for emergencies need be installed, and operating expenses can be reduced by rendering repairs easier, owing to greater facilities for shutting down for work or for inspection.

EXTENT OF WATER-POWER DEVELOPMENT.

The statistics of water power collected under the direction of Congress several years ago and embodied in the report of the National Conservation Commission of 1909 show that there is at present developed in the United States about five million horsepower of water power. The amount of power produced by steam from coal is difficult to estimate, but it is considered to be about 27,000,000 horsepower, and is rapidly increasing with attendant depletion of coal reserves. A large part of this it is not only possible but easy for water power to replace if it were made freely available through development. With range of development at a cost of investment that would make the cost of such power about equal to that of steam power, there is still undeveloped in the streams of the United States about 35,000,000 horsepower. Any action by Congress that would accelerate the release of this power would conserve enormous supplies of coal for such domestic and industrial purposes, as only coal can supply.

Transcontinental Telephone.

President Vail, of the American Telephone & Telegraph Company, has announced that Puget Sound cities will be able in another year to talk to Chicago or New York. At present connections end at Salt Lake City, Utah, and Denver, Colo.

"I believe the time will come," President Vail said, "when there will be only one telephone system in the country. I don't know whose that will be, but I hope it will be ours. When a person wants telephone service he desires to handle all his business on one telephone. For long-distance service only one telephone is possible."

Tacoma and Seattle have independent local telephone companies and long-distance services, which compete with Bell companies over a large territory. One independent long-distance company is now in a receiver's hands there, with reorganization nearly completed. In both cities there has been agitation in favor of municipal ownership, but the business element favors the consolidation of independent and Bell systems.

President Vail declared that one system is best for any city of local situation and added:

"The public wants to be protected against an oppressive monopoly. When Puget Sound cities and the State of Washington signify that they want only one telephone system, and demonstrate that they will make a business-like proposition, we will see that their wants are fulfilled."

Mr. Vail also states that a telephone line between Los Angeles and New York would probably be ready by November 1, 1912. It will cost $500,000 for line alone, and the cost per conversation will probably be between $14 and $15.

Electrical Notes From Great Britain.

By Our London Correspondent.

On Tuesday, November 14, at the Institution of Civil Engineers in London, two papers were read by A. H. Roberts and F. B. Sonnenschein respectively on "Loch Leven Waterpower Works" and "The Hydroelectric Plant in the British Aluminum Company's Factory at Kinlochleven." An account of the leading electric features in this undertaking has already appeared in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN. On November 15 the Manchester Section of the Institution of Electrical Engineers met jointly with the Liverpool Engineering Society to discuss the function of the laboratory in the training of an engineer, the subject being opened by Prof. E. W. Marchant. At the Junior Institution of Engineers in London, William Marconi delivered his presidential address on November 28 on "Engineering Considerations in Wireless Telegraphy." The Physical Society holds its annual exhibition of apparatus—always an important event electrically—on December 19.

In the course of a recent address E. K. Scott mentioned the possible consequences of the threatened legislation relating to the use of electricity in coal mining. He was addressing one of the branches of the Association of Mining Electrical Engineers and said that unless they were very watchful it might follow that the proposed bill would stay all progress just as had happened as a result of the obstructive electric lighting legislation of 1882. In certain cases, it might be, colliers which could only be worked satisfactorily electrically, would have to be shut down. At another meeting Prof. W. M. Thornton said that the government had withdrawn the clause of the coal-mines bill requiring that where half of one per cent of gas was present electricity must not be employed. The British Electrical and Allied Manufacturers' Association circularized all the members of the House of Commons on the subject early in November.

Professor Stanley indicated the rapid progress that is now taking place here in the application of the individual-motor drive in textile factories, in an address to the Belfast Association of Engineers. Whereas last year not more than three hundred motors had been used for this purpose, they were now being installed by hundreds in many of the largest Lancashire, Yorkshire and Scottish mills. He spoke of one electrical manufacturer who had alone, since last January, supplied two thousand motors for this purpose and now has in hand inquiries for a further five thousand. Professor Stanley mentioned a Lancashire mill which had since electrification increased its production by from 12 to 18 per cent, with an improved quality of yarn. He foretold a revolution in loom machinery within the next five years as a consequence of electric driving progress. A further point, and one of considerable interest, was the professor's suggestion that a large central electric power supply system be established in the North of Ireland, as factories were bound to be erected there.

The Marconi Wireless Telegraph Company has now held its meetings at which the necessary sanction has been given for increasing the capital by $1,250,000 to enable it to develop in various parts of the world where there is ample scope. In Russia and the East generally there is recognized a big field, and in order to take advantage of the opportunity, the company has secured a controlling interest in the Russian Company of Wireless Telegraphy & Telephony. The Marconi concern has also been in negotiation with the British government in connection with the great scheme of Imperial wireless stations. To use the company's chairman's expression, a recent arrangement made with the Lodge-Muirhead Wireless & General Telegraphy Syndicate has "broken the back" of the litigation through which it was necessary for the Marconi interests to pass, and little remains to be done in this direction "in this country." All patent-right disputes between the two concerns have been settled, the Lodge-Muirhead patents have been taken over, and Sir Oliver Lodge now appears as a scientific adviser to the Marconi company.

A number of the other local authorities and companies, beside those already mentioned in these notes in recent months, intend applying for Parliamentary powers to run railless electric cars. Notices of applications have to be filed before the end of November for the next Parliamentary session. Edinburgh Corporation has decided to postpone its application until it has investigated the claims of a new London petrol-electric omnibus.

The tramways of the city of Oxford are still drawn by horses. There have of course been many battles at different times with reference to threatened change to electric traction, but the City Councillors have a terrible dislike for the overhead trolley, which it is considered would disfigure certain thoroughfares and disturb the calm and quiet there. As a result of the last full consideration of the position, a company secured a concession under the terms of which it bound itself to run a conduit section through this trolley-prohibited route, using the overhead wire elsewhere, the change to be effected by the year 1912. But no active work has yet been done.

No subject has received greater attention among electrical engineers here during the past month than the proposed alterations in the Articles of Association of the Institution of Electrical Engineers. It would take a great deal of space to explain the many points in which there have occurred very wide differences of opinion between the members of the Council responsible for the proposals, and the various classes of members who will be affected by them. There have already been two gatherings in London at which very strong opposition was expressed, and other meetings are to follow. Meetings of the local sections are being called at which the president, S. Z. de Ferranti, and members of the Council will attend to listen to criticisms and suggestions and answer questions. If one thing be plainer than another at the moment of writing, it is that some of the proposed new articles will have to be revised considerably, but it is unlikely that all the sweeping proposals of active opponents will be accepted. There are, it seems, two desires among members as to the future of the Institution policy, and, apart from the matters of detail, one of these is that the Institution should become more industrial or commercial in certain respects, the other being the wish to continue it as a purely scientific and engineering

body. The Council has to pick its way between the two conflicting desires.

The North London Railway is to be electrified and probably, owing to its connections, the direct-current system will be adopted. It is owned chiefly by the London & North Western Company, has a length of fourteen miles, and, considering the great loss of traffic owing to electric-tramway, motor-bus and electric-tube competition, the wonder is that the conversion was not effected long ago. The electrification of this line is only part of a scheme for providing a complete system of electric railroads by the London & North Western and the North London routes from Watford, via Chalk Farm, to Broad Street Station. From Queen's Park Station there will be a new tube railroad constructed by the London Electric Railway Company to form an extension from the Baker Street and Waterloo tube, and also a connecting link between the whole of the London tube railroad system and the London & North Western Railway. In respect to electric railroad developments generally, it is understood that the experiments with the Scottish turbo-electric locomotive after the Heilmann principle have not come up to expectations. It is also said that some of the English railway companies are making experiments with petrol-electric locomotives, and that in one case a 500-horsepower Diesel engine electric locomotive has been designed.

Some time ago the Glasgow Tramway Committee sent a deputation to Continental and English plants to inspect various types of turbine, new apparatus having become necessary at the Pinkston power station, and later for the new big power station for which plans have been made. The report of the deputation is of considerable interest. At Pinkston station the reciprocating sets are used simply for emergency purposes, and this practice was observed in most other works visited. The question of cost was not regarded as of great importance. The deputation advised that two turbines be ordered for Pinkston instead of one, so that the whole load might be taken up by turbines. One of these is to be of the pure impulse type (Curtis) by the British Thomson-Houston Company, and the other of the impulse-reaction type (Richardson-Westgarth), with Brown-Boveri alternator. With these new sets in position the department will have under observation at Pinkston one each pure reaction, pure impulse, and impulse-reaction types, and the performances of these will have much weight in the choice of the type of machinery employed when the new station has to be equipped.

The need for a new policy to be adopted deciding the future of London in respect to its electric power supply, is a subject under discussion just now. The company undertakings become liable to purchase by the London County Council in 1931, and, having that date in mind, the Council's Finance Committee thinks that the time has arrived for an endeavor to be made to arrive at an agreement as to future lines of development on the part of all the supply asthorities. The linking up of isolated borough-council undertakings in the metropolitan area for mutual support and economy is advocated as being preferable to the extension of a number of comparatively small and in some cases unprofitable concerns which will, on economical grounds, have to be scrapped some day.

Poplar, a borough of London, proposes to make a big improvement in the lighting of its streets, and the lines adopted are indicated by the following proposals: Flame-arc lamps are to take the place of existing open-type arc lamps; 600-candlepower incandescent lamps are to replace ten-ampere open arc lamps; 300-candlepower incandescent lamps are to replace 7.5-ampere open arc lamps. All gas lamps are to be replaced by electric incandescent lamps as soon as mains are laid. As the efficiency of the metal-filament lamps will undoubtedly improve, the candlepower is to be increased in proportion to the increase in the efficiency of the lamps. The fixed charge for public lighting will be reduced from $65 to $55 per kilowatt per year. The whole of the improvements contemplated are to be paid for out of future economies realized in lamp maintenance and supply of energy.

The Constantinople Telephone Company which,it will be remembered,owns a concession (thirty years extensible to forty years) procured on behalf of an Anglo-French-American group, has just appealed to British investors to take up $1,500,000 in ordinary shares on which five per cent is payable during the construction stage. One condition of the concession is that the Turkish Government is to receive as royalty fifteen per cent of the gross telephone revenue. First of all, a plant of ten thousand lines capacity is to be installed, and the period of initial construction is estimated at eighteen months. A staff of engineers has been employed on the preparatory work for the past four months. The population of the area to which the concession applies is a million and a quarter. The measured rate tariff will apply for all purposes save private residences, and for these there is a flat rate.

ALBERT H. BRIDGE.

London, November 28, 1911.

Corrosion of Iron and Brass.

Thomas Turner, of the Birmingham University, England, in lecturing before the Metallurgical Society, recently, discussed the question of corrosion. Various chemical and physical theories have been advanced to account for the production of rust, but almost every month brings fresh results, and these are frequently contradictory. In practice corrosion is almost always the result of the action of air and water and a weak acid; but it appears to have been proved that pure iron is soluble to a slight extent in chemically pure water.

Some recent experiments show that when cast iron is attacked by weak acids the iron is first dissolved, the carbides and phosphides resisting better. With alkaline corrosion, on the other hand, the impurities are first dissolved and the iron remains undissolved until last.

Special attention has recently been paid by scientific workers to the corrosion of brass, and especially to that of condenser tubes, which in the mercantile marine is a cause of much loss and inconvenience. A special committee has been appointed by the Institute of Metals to investigate this subject, and experimental apparatus is being installed at the University of Liverpool.

The Bowen research scholar in metallurgy, Mr. Bruhl, has determined the electric potential of various corrosion products and their conductivity in the wet and dry state. He made various alloys and tested them, concluding that the addition of tin up to about one per cent and somewhat larger quantities of lead and of aluminum diminished the corrosion in brass containing over seventy per cent of copper.

Electrical Notes from Continental Europe.

By Our Paris Correspondent.

Limoges, France, is the centering point of an extensive system of light railroad lines which radiate through the country so as to cover quite a large area. The total length of the electric railroads is now over 200 miles. The region in the neighborhood of the town is populous and well cultivated, so that the lines are handling considerable freight traffic. Single-phase current at twenty-five cycles is adopted here, and the overhead trolley wire uses 600 and 10,000 volts. Current for the electric roads is supplied by two stations of some size, one of these being a hydraulic plant situated on the Vienne River at Eymoutiers and the second a steam plant near Limoges.

Within the town the line is operated at 600 volts, using 10,000 volts for the remainder of the system. For the outside lines a catenary suspension is adopted for the trolley wire, a novel point being the use of galvanized-iron wire for the trolley wire. This is of a figure-eight section and is of eighty square millimeters section. The trolley lines for the four main electric roads branching out from Limoges are of an average length of about forty miles, but the whole of this length is operated without the use of transformer posts along the line. The trolley wire is divided into sections of two miles length and a special iron tower is planted at the ends of the section so as to stretch the wire by means of a counterweight. The section switches are also located at these points.

Two types of motor car are used on the lines, one of these being a small double-axle car without bogie, and the second a bogie truck car. For the smaller car a single pantagraph trolley is mounted on the roof, and the truck carries two fifty-kilowatt motors upon the axles. It is used for the city and suburban service, while the double-truck car runs upon the longer lines and carries four fifty-kilowatt motors of the same type as above. Two pantagraph trolleys are used here. The motors are of the Siemens compensated series type, built by the French Creil works. All the motors are connected in parallel. The reduced voltage for the motors is furnished by an auto-transformer carried on the car.

The Eymoutiers hydraulic plant which supplies the above system of electric roads is one of the most recent in France. A forty-foot dam is erected upon the Vienne River. A single penstock of 5 feet 6 inches in diameter is erected at present, and it supplies two Francis turbine groups of 1,500 horsepower each, with a fall of 170 feet. The alternators furnish current at 850 volts and twenty-five cycles. Transformers raise the voltage to 32,000 volts for the power line, and this is again reduced to 10,000 volts at the Limoges station. A steam plant is also erected in the latter station, this plant operating in parallel with the 10,000-volt system. Two Dujardin engine-driven alternator sets are used to supply the power. The switchboard and busbars receive the 10,000-volt current from both sources and feed it either directly to the 10,000-volt trolley wires or through transformers to the 600-volt lines.

The Siemens-Halske and the Allgemeine Electricitäts Gesellschaft of Berlin have made a combination which results in the founding of the Berlin Ozone Company. Its object is to manufacture ozone producers for various purposes, among others for large water-purifying plants. The Siemens-Halske firm already owned a number of patents which are applied in ozone plants at Paderborn, Chemnitz and other places in Germany, also in Florence and other cities. The Allgemeine firm controls the Otto ozone producer which is put upon the market by the French Ozone Company of Paris. It has been installed for water purifying purposes in several towns such as Chartres and Nice, in France, and a plant has also been erected at Paris for handling 2,000 cubic meters of water per hour. The two firms worked together some time ago in installing the large St. Petersburg ozone plant for treating the water of the River Neva. From now on, the operations of this kind are to be carried out by the new Berlin Ozone Company.

Several nations are concerned with projects for wireless communications on a large scale by erecting a number of stations in the colonies so that messages can be sent from one to the other and thus cover great distances. According to the French project, messages will be even sent around the globe by forming a chain of stations to be erected in various colonies. Paris will connect first with the stations in Africa at Tombucton or Timbuctoo and Dahomey in the western region. Then messages will be forwarded from there across the continent to the east coast at Djibouti. Farther south, Madagascar will also receive telegrams. Messages will cross the Indian Ocean to India at Pondichery and will be then sent to the east coast of Asia at Saigon. The 5,000 miles of sea separating this point from New Caledonia can be crossed by waves from a high power station. Two posts will be erected in the Pacific at Tahite and the Marquise Islands, then the waves will cross Central America to Martinique, a distance of 5,100 miles. From here they will cross the Atlantic to a station on the west African coast at Rufisque and from there the messages will be sent to the Eiffel Tower station at Paris. Thus it will require but twelve wireless stations to connect all the colonies with the capital and besides to send messages around the globe. A commission has already been appointed by the French Minister of Colonies, with M. Ferner the chief of the Eiffel Tower plant, at the head of the technical post. The enterprise will not cost more than $2,500,000 and can be carried out in two or three years. Great Britain is also engaged upon a project of a similar nature, and Germany is also to erect a number of stations for long-distance messages.

Artificial rubber is said to have been produced from soja oil by two German chemists. This oil is prepared from the soja bean which is grown in China and has many valuable qualities. To obtain the artificial rubber, the oil is mixed with half its weight of nitric acid so as to give an emulsion, and this is heated to the boiling point of water. At the end of the heating there is produced a very uniform spongy mass. This is washed with water and then dissolved in five-per cent ammonia, from which it is precipitated by a dilute acid. The precipitate is then washed, pressed and dried at fifty degrees centigrade. The result of these

operations is an elastic substance resembling rubber and it is claimed that it can be vulcanized in the same way as natural rubber.

Among the large power plant projects in Germany may be mentioned the two turbine stations which are to be erected upon the Rhine not far from Basel. The enterprise is the result of an agreement between the Swiss Government and the Grand Duchy of Baden, in order to secure a considerable amount of power from the Rhine. Dams will be built in two places, at Angst-Wylen and at Haufenburg, lying eight and twenty-seven miles from the city, respectively. The first of these dams will be thirty-five feet in height and will raise the water level to twenty-five feet above low-water stage. Near by will be erected a turbine house which will furnish about 15,000 horsepower; locks will also be provided for navigation at this point. The dam is to cost about $1,000,000. At Haufenburg, the dam will be fifty feet in height and will resemble the former, raising the level to thirty-five feet above low-water stage. The turbine plant to be erected here will rank among the large European stations, as it is expected to give 50,000 horsepower. The dam at this point is to cost $750,000.

According to the plans of Secretary Chaumet of the French Postal and Telegraph Department, Paris and the rest of France are to have the much needed reform which the public has been awaiting for a long time past. This is especially true as regards the telephone system. The Subscribers League, headed by Marquis De Montebello and including many influential persons was formed some years ago in the hope of mending matters, but has not been able to obtain much satisfaction from the Government up to the present. It will, however, become a prominent factor from now on. M. Chaumet has been occupied with the reform ever since he assumed the position of secretary, and in a recent interview he states that he is to appoint a special commission to this end, in which the public will participate to a large extent. As a result of this measure, the telegraph and telephone department will hear all the objections which are made to the service and if satisfaction is not given, the public will at least know the reason and it will see all the difficulties in the way.

The German Körting firm has lately built a type of gas engine which uses tar from gas works as fuel. The engine follows the Diesel internal combustion principle and is said to be a success. The Continental Gas Company promoted the idea in the first place, in order to obtain a source of power from the tar coming from coal distillation. Of the 100-horsepower size, the new engine is coupled to a direct-current generator, and it runs in parallel with ordinary gas-engine groups. For starting up and heating the engine, paraffin oil is employed. Upon a seventy-hour endurance test upon two-thirds load, the engine showed a good performance, and at the end of the test all the inside parts were very clean and showed no deposit from the tar. It also runs at very regular speed so that it will be very good for small electric plants. Larger engines of 600-horsepower are to be built in the near future.

M. Recklinghausen of Paris has succeeded in producing a mercury-vapor lamp which gives a good white light. It is now being put on the market by the French Westinghouse Company. In order to add the red rays which are lacking, he uses the fluorescent properties of rhodamine. This substance absorbs many of the rays, which are characteristic of mercury, and gives off red rays instead. As it is not practicable to surround the mercury-vapor lamp with a screen of this substance, it is used instead as a reflector. Above the tube is a concave reflector which is coated with the substance, and it serves to reflect red rays so that these are added to the rays from the tube. The result is a white light which preserves the natural colors of objects and thus does away with the objections to mercury-vapor lamps.

A. De Courcey.

Paris, November 29, 1911.

Oil in Alaska.

Petroleum has been found in Alaska, and while there has been practically no production, it is not impossible, according to the United States Geological Survey, that commercial pools may be found.

Next National Independent Telephone Convention.

The next annual convention of the National Independent Telephone Association is to be held in Chicago, Ill., on February 7, 8 and 9, 1912.

A Novel Electric Floor Polisher.

The accompanying illustration shows a unique electric floor surfacing and polishing machine developed at Oskaloosa, Ia. This electric machine has ball bearings and is self propelling. It has two drums covered with sand paper or any abrading material, the drums being provided with clamps to clamp and draw the paper tight around these.

It may be stated that the drums are seven inches in diameter, fifteen inches long, and run 800 revolutions per minute. The machine is geared to travel twenty-five lineal feet per minute, the cutting pressure being put on the floor by the operator's foot, as shown in the photograph. It takes a five-horsepower motor to run the machine under normal conditions. It is claimed that this

ELECTRIC FLOOR POLISHER.

electric machine does perfect work on all kinds of floors from the finest parquetry to the common yellow pine and does not show waves. Old finish and old paint, can be cut from old floors and same made like new,. it is maintained, at slight expense while any quality of finish that may be desired can be made by using the different grades of sandpaper. The machine is forty-six inches long and eighteen inches wide and weighs with motor 750 pounds.

Imports of Coal.

The imports of anthracite amounted in 1910 to only 8,195 long tons, valued at $42,244, and those of bituminous coal to 1,497,709 long tons.

EFFECT OF FREQUENCY ON THE CAPACITY OF A CONDENSER WITH KEROSENE FOR THE DIELECTRIC; AND THE LIMIT OF THE WHEATSTONE BRIDGE FOR MEASURING CAPACITIES.[1]

BY S. HERBERT ANDERSON.

In carrying out some experiments with the Poulsen arc, it was desirable to have a variable condenser whose capacity would be independent of the frequency and potential used. A condenser was built consisting of a set of fixed metal plates and a set of movable plates, and kerosene was used for the dielectric. It was thought worth while to find out just how the capacity of such a condenser varied with the frequency.

First, the capacity was measured for static conditions, by an absolute method; that is, by charging the condenser by a known potential and discharging through a ballistic galvanometer. The values of the capacity for different times of charging are as follows:

Time of Charging in Seconds.	Potential in Volts.	Capacity in Microfarads.
5	150	0.000806
4	150	0.000744
3	150	0.000707
2	150	0.000689
1	150	0.000676
0.2	150	0.000665
0.08	150	0.000671

Hence, allowing for experimental error, for a time of charging of one second or less the capacity is constant. But for a time of charging greater than one second there is an absorption in the dielectric.

In the second place the capacity was measured for frequencies ranging from 14.5 to 94, by a method due to Fleming and Clinton, by the use of a rotating commutator. The results show that the greatest departure of any value obtained from the mean is 0.6 per cent; so we may consider that the capacity is constant for this range of frequencies.

Frequency.	Potential in Volts.	Capacity in Microfarads.
14.5	24.6	0.000654
16.0	24.6	0.000652
19.3	24.6	0.000655
19.7	24.6	0.000654
23.0	24.6	0.000659
28.4	24.6	0.000659
31.1	24.6	0.000654
37.2	24.6	0.000654
38.9	24.6	0.000657
46.4	24.6	0.000657
94.0	16.4	0.000660
	Mean	0.000656

In order to test the capacity for the frequency used with the Poulsen arc, the condenser was placed in an oscillation circuit, consisting of a rectangle of No. 20 copper wire, 363 by 55 centimeters. The electric oscillations were produced by the spark discharge from an induction coil between zinc-ball electrodes 1.8 millimeters apart. This spark length corresponds to a potential of about 7,400 volts. A second oscillation circuit consisting of a Flemming cymometer was loosely coupled with the first circuit and adjusted until in resonance with 1. (See Fig. 1.) Then the condenser was replaced by a

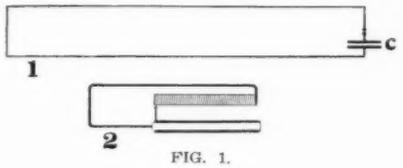


FIG. 1.

variable air condenser which had been previously calibrated, and this was adjusted until 1 was again in resonance with 2. Then the capacity of this air condenser was that of the kerosene condenser. By changing the self-induction of 1 the frequency could be changed, the frequency being given by

$$n = 1/2\pi\sqrt{LC}$$

The capacity was measured for frequencies of 400,000 and 1,750,000 and found to be in both cases 0.000669 microfarads. As this differs from the value obtained by the Fleming-Clinton method by only two per cent, and as the accuracy of the resonance method is not greater than this, it was concluded that the capacity was constant for frequencies up to 1,750,000.

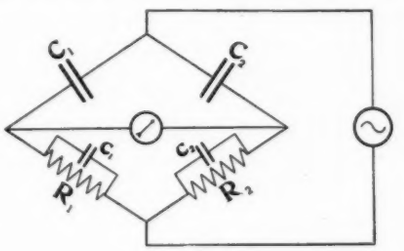


FIG. 2.

As a further check upon these determinations, an attempt was made to measure the capacity by a Wheatstone-bridge method, using currents of various frequencies. It was found impossible to get with any accuracy a point of balance. It was suspected that the difficulty lay in the fact that the resistance coils used had capacities of the same order as that to be measured. An examination of the conditions that must be satisfied for a balance when such is the case shows the impracticability of this method.

Let C_1 be the capacity to be measured; C_2 a standard condenser; R_1 and R_2 the resistances having in the coils capacities c_1 and c_2 respectively (see Fig. 2). It can be shown that for a balance

$$R_2/R_1 = C_1/C_2$$

and

$$C_1/C_2 = c_1/c_2$$

Hence

$$R_2/R_1 = c_1/c_2$$

That is, for a balance, in addition to the well known condition that the ratio of capacities must be the inverse ratio of the resistances, we have a second condition that must be satisfied, *viz.*, that the ratio of the auxiliary capacities in the coils must be the inverse ratio of the resistances, which condition is not complied with in the manufacture of resistance boxes.

S. L. Brown, at the University of California, found the capacity of a 1,000-ohm coil, Chaperon-wound, made by Hartmann and Braun, was 0.000105 microfarads, and of the 1,000-ohm coil of the Wolff resistance boxes 0.000735 microfarads. As these capacities are of the same order as the capacity to be measured, the impossibility of getting a balance is explained.

[1] Abstract of paper presented at meeting of American Physical Society, Chicago, Ill., December 2, 1911.

Rights of Mutual Telephone Companies.

The right of the farmer's mutual telephone companies to operate in Ohio has been questioned by both the independent and Bell companies doing business in that state. It is claimed that an effort is being made by both these interests to prevent physical connections and interchange of service for the benefit of rural patrons. Thousands of rural homes are supplied with telephones furnished by purely local concerns which have no capital stock and which meet their expenses by levying an assessment for this purpose upon members. The new public utilities commission act contains provisions intended to protect these concerns. A number of them, including the Kilbourn Mutual Telephone Company, have filed petitions asking for connection and interchange service. No decision has yet been announced.

Exports of Copper.

Exports of copper for the week ended November 30 were 3,755 tons. The figure for the month is 26,431 tons, as compared with 29,097 tons for the same period last year.

Meeting of Central Electric Railway Association.

The fourth bi-monthly meeting of the Central Electric Railway Association was held in Louisville, Ky., on November 23. This was the first meeting of the Association held in a Southern city and the attendance was unusually good. Two special cars from Indiana and one from Ohio brought the larger number of traction men to the meeting, these trains being run by the Indianapolis, Columbus & Southern and the Western Ohio Interurban Companies.

The morning session was called to order at 9 o'clock by the president, B. B. Peek, who announced the appointment of the members of Nominating Committee for the election of officers at the annual meeting in January. These members as announced are: F. D. Carpenter, H. A. Nichal, E. F. Schneider, M. J. Insull, and S. D. Hutchins.

M. M. Buckman presented the report of the Standardization Committee relating to the anti-climbers recommended at the last meeting. He distributed blue prints of the anti-climbers with the dimension recommended.

Owing to the limited amount of data gathered, the Committee on Lightning Arresters declined to make specific recommendations but cited some of the qualifications necessary for a satisfactory arrester. The committee was given further time to report on the subject.

On motion of C. L. Henry a resolution providing for the merger of the Central Electric Accounting Conference with the Central Electric Railway Association was adopted.

"Publicity" was the subject of the first paper which was read by John J. Rockwell, of New York. Mr. Rockwell spoke of the several branches of his subject and gave a number of illustrations showing the necessity of publicity. He said there was no greater problem before the electric railway officials than the problem of publicity and judicious advertising.

A. W. Brady, John F. Starkey and Edward F. Schneider discussed the paper briefly. Mr. Brady remarked that the matter of publicity and advertising is constantly attracting greater attention from electric-railway managers and he commented on the attention given to publicity, which was a feature of the Atlantic City convention. The interurban lines, he said, had given a great deal attention to the matter of advertising as a means of increasing traffic. He thought, however, much more could be done especially as a matter of necessity where lines parallel steam lines which advertise very extensively.

Mr. Starky said he was an advocate of advertising but it is well to remember that "action speaks louder than words," and that satisfactory service, clean, comfortable cars and courteous trainmen were the best possible and most effective advertising.

Mr. Schneider contended that the roads were to blame in part for present conditions because they do not take the public into their confidence. Representatives of the newspapers and journals should be furnished with all the facts, and the progress of the roads kept constantly before the public.

"Traffic" was the subject of a paper by Frank D. Norviel, traffic manager of the Indiana Union Traction Company. Mr. Norviel dwelt upon the necessity of good equipment, prompt shipments and courteous freight handlers. He spoke at length on the several classes of business and cited the best methods, according to his experience of handling each class.

E. E. Wynne read an illustrated paper on "The Electric Locomotive for Interurban Freight Haulage." Mr. Wynne said the purpose of his paper is twofold: First, to call attention to a few facts relating to the present status of interurban freight haulage; second, to outline a method for selection of a locomotive for a given service. He treated the two divisions of his subject quite at length illustrating his points in such a way as to show the marvelous possibilities of the electric locomotive for hauling freight. In answer to a number of questions Mr. Wynne said he believed in slow-speed heavy traffic, rather than small high-speed freight traffic.

"Lightning Protection" was treated in a paper by E. J. Burdick. Mr. Burdick sub-divided the subjects into four heads: (1) Power-house and substation protection; (2) distribution protection; (3) car protection; (4) telephone-terminal and line protection.

Each of these subjects was discussed by the author and the hazard of lightning to electric-railway properly gone over thoroughly. He pointed out the most effective plan to afford efficient protection and insisted on the necessity of frequent and systematic inspection of the property in its entirety and more especially the power house and distribution lines.

J. E. Cochran read a paper on "Substation Operation," which brought out a hearty discussion largely in the nature of questions which were satisfactorily answered by Mr. Cochran. The interesting matter brought out in Mr. Cochran's paper resulted in the appointment of a committee to adopt a general set of rules to govern the operation of substations and the cutting out of high-tension lines.

G. H. Harries, vice-president of the American Electric Railway Association, addressed the meeting briefly emphasizing the importance of creating and maintaining harmonious relations with the public.

At the close of the convention announcement was made that the annual meeting of the Association will be held in Dayton, O., January 25, 1912.

Radium Institute in Bohemia.

At Joachimsthal, Bohemia, the Government has erected an institute which is to be devoted entirely to the use of radio-active substances for medical purposes. This locality first came into prominence with the discoveries of Becquerel and Curie in Paris, whose experiments were made on vranium obtained from material found in the mines of Joachimsthal.

A syndicate was at first organized for the purpose of exploiting this natural resource, but public opinion forced the Government to assume control of the affairs and to erect a therapeutic institution accessible to all classes of the population.

From the material obtained in these Government mines a large quantity of radium bromid could be manufactured, and in the institute all kinds of treatment by radio-active substances will be given. The building was recently opened; it contains radio-active baths and a large quantity of radium salts, and will be open all the year around. By pipes the water is drawn into the baths directly from the bottom of the mines, and filtered in such a way that it does not lose any of its activity.

The institution is in charge of an expert medical radiologist from the Vienna University.

Central-Station Practice

MODERN HIGH-VOLTAGE POWER TRANSFORMERS.[1]

BY WILLIAM T. TAYLOR.

Manufacturers of transformers are now prepared to build them in units above 15,000 kilowatts and at 200,000 volts. One large factory is using annually about 6,000 tons of steel and about 2,000 tons of copper in the manufacture of transformers.

Commercial transformers have already been built for and are operating at voltages as high as 500,000 volts in small units of 200 kilowatts. The author believes there will shortly be transformers in operation in testing departments at much higher voltages than even this, and also that power transformers will be built in units of 20,000 kilowatts at 200,000 volts.

Whenever water is available and not expensive, water-cooled transformers are preferable to air-blast transformers of large and moderate sizes (2,000 to 10,000 kilowatts), as it enables the operation of transformers at lower temperatures and thus allows more margin for overloads.

The fire risk of air-blast and oil-filled transformers depends as much on surrounding conditions and the location of the transformers as on their construction. The air-blast transformer contains a small amount of inflammable material compared with the oil-filled transformer, but this material is much more readily ignited. The chances of an oil-filled transformer catching fire on account of any short-circuit in the windings are extremely small, as the transformer is completely submerged in oil, and no air can get to it. Moreover, the oil used in transformers is not easily ignited. The idea of placing oil-filled transformers in separate compartments is not thought so necessary now as it was some years ago.

The "all-day" efficiency is an important matter to operating engineers, and in general it is found that transformers will operate economically and quite satisfactorily when worked at their limiting temperature rise. The increase in first cost of transformers which are too large is greater than the capitalized cost of the reduced losses, and a careful study of the conditions governing the loads should be made before a final decision is taken as to the exact size to adopt for a given service. It is unwise to follow strictly a rule of choosing equal kilowatt capacity for equal generator units, although in some particular cases this will hold.

Not very long ago a transformer was designed known as the "forced-oil type," the first designs having their oil-cooling outfit external to the transformer. Modern designs of this type have their cooling coils located within the transformer tank, being separated from the main body of oil by a sheet-steel diaphragm. The heated oil is pumped from the top of the transformer and discharged into the upper part of the cooling compartment, and by continuous operation of the pump the cooled oil flows out from the bottom of the compartment and up through the spaces or ducts between the windings and the core. The forced-oil-cooled transformers are used in sizes above 2,500 kilowatts for single-phase and 7,500 kilowatts for three-phase.

TABLE I.

	Output in kilowatts.	Load efficiencies. 100%	75%	50%	25%	Gals. of oil.	Gals. of water per min.
25 cycles.	100	95.3	95.0	94.1	90.2	200	2.0
	200	96.4	96.2	95.3	92.0	250	3.0
	500	97.3	97.4	96.9	95.4	750	5.0
	1,000	97.8	97.8	97.4	96.2	1,400	8.0
	2,000	98.3	98.3	98.0	97.1	1,800	13.5
	4,000	98.7	98.7	98.5	97.7	2,300	21.0
60 cycles.	100	95.6	95.4	94.4	90.8	100	2.0
	200	96.6	96.3	95.3	92.0	200	3.0
	500	97.3	97.0	96.3	93.5	600	5.0
	1,000	98.0	97.8	97.2	95.2	650	7.5
	2,000	98.4	98.2	97.8	96.1	1,600	12.5
	4,000	98.8	98.7	98.3	97.0	1,950	19.5

In Table I there is shown a class of single-phase oil-filled water-cooled transformers, for 25 and 60 cycles, respectively, 66,000 to 6,600 volts, giving the efficiencies at various loads, with a maximum temperature rise of forty degrees centigrade at full load.

The regulation of the twenty-five-cycle transformers for non-inductive load varies from 2.5 per cent to 1.6 per cent in sizes up to 300 kilowatts, and to 1.2 per cent at 4,000 kilowatts; while the regulation of the sixty-cycle list varies under non-inductive load from 2.3 per cent to 1.4 per cent in sizes up to 300 kilowatts and and to 0.90 per cent at 4,000 kilowatts.

The usual designs of core-type transformers made have a uniform distribution of dielectric flux between high and low-voltage windings, except at the ends of the long cylinders, where the dielectric flux will be greater and its distribution irregular.

The "shell-type" water-cooled transformers and forced-oil-cooled transformers are built in larger sizes than the core-type transformers, the former type having been built in 6,000-kilowatt, single-phase units and 10,000-kilowatt three-phase units.

In a three-phase shell-type transformer constructed so as to form a single structure, the reduction of steel for the magnetic circuit amounts to from ten to twenty per cent of that used in three single-phase transformers placed side by side.

In this type of transformer it is difficult to insulate the large number of edges and sharp corners exposed between adjacent high and low-voltage windings and between windings and core. At these places the dielectric density is very great, and it is a much more difficult matter to insulate them than the ends of the cylindrical coils of a core-type transformer. Much more insulation is required, and consequently a larger space-factor. The result is lower efficiency and worse regulation, and consequently a heavier and more expensive transformer for a given output and efficiency.

Air-blast transformers are regularly built in capacities up to 4,000 kilowatts, and for a voltage of 33,000. Their efficiency, in good designs and with the required amount of air pressure, is slightly better than that of the oil-filled water-cooled transformer of the same capacity. The general design is very much like that of the ordinary shell-type transformer, with the exception of a few modifications in the iron assembly, where certain air spaces are left open for the circulation of air. The temperature of the outgoing air compared with the temperature of the ingoing air is

1 Abstract of paper read before the Institution of Electrical Engineers, London, November 9. From *Electrical Review*, London, November 24.

the best indication whether sufficient air is passing through the transformers; if there is not more than twenty degrees centigrade difference, the supply of air will be found sufficient. As transformers are generally designed on the basis of twenty-five degrees centigrade, the best results are obtained when the temperature of the incoming air is not greater than this value.

Very special care and knowledge are necessary on the part of those whose duty it is to dry out transformers, for the difficulty is not so much in drying the coils, but in drying the whole insulation surrounding them and the core. No matter for what factor of safety the transformer has been built, it avails little in the case of carelessness or neglect to dry out the transformer properly.

Before transformers leave the factory they are given a high-voltage test, the standard being to apply twice the rated voltage between the high and low-voltage windings, the latter being connected to the iron core. It is now believed that the greatest cause of failure in high-voltage transformers arises from punctures between turns and not between the high and low-voltage windings.

In the air-blast transformer careful examination should be made about once a month to see that the air-circulation ducts are quite free from the accumulation of dirt and dust. In the case of oil-cooled transformers, samples of the oil should be drawn from the bottom of the tank about once a month and tested, and a record kept of its condition. It is desirable, for the purpose of preventing condensation on the oil surfaces and other inside transformer surfaces, to keep the oil at all times at least ten degrees centigrade above the room temperature.

The most important characteristics of transformer oil which interest the operating engineer are summed up in Table II. These values are a standard minimum for 0.2 inch gap. Quality (A) is for oil-cooled, and (B) for water-cooled transformers.

TABLE II.—OILS FOR HIGH-VOLTAGE TRANSFORMERS.

	Quality (A).	Quality (B).
Flash-point	185° C.	129° C.
Fire test.....	210° C.	149° C.
Viscosity	105 seconds	39 seconds
Breakdown test....30,000 volts		40,000 volts

For oil-filled water-cooled transformers it is customary to use another grade of oil than that used in the self-cooled type, the oil operating at a lower average temperature, consequently a high flash-point is not of so much importance.

Usually oil is received abroad testing less than 30,000 volts per 0.2 inch, but before it is placed in the transformer it is brought up to test at least 30,000 volts per 0.2 inch for transformers designed for an operating voltage of 44,000 volts and under; not less than a 44,000-volt test per 0.2 inch is required for oil used in transformers operating above 44,000 volts. The water present must not exceed 0.001 per cent, in order to obtain a dielectric strength of 40,000 volts in the standard test (0.2 inch between 0.5 inch disks).

Some people think that once a transformer has been put into successful operation it will continue to operate satisfactorily for an indefinite time without any attention. This is a wrong idea. Transformers require attention, and must be given attention, or else they will not give good service.

The efficiency of a transformer is usually considered its most important feature by the majority of station engineers and managers operating local distribution systems. By transmission engineers this feature is not considered to be the most important, but rather the insulation of the transformer, and consequently its reliability, next to which comes safety, then efficiency.

Many breakdowns of large power transformers have been recorded resulting from the stoppage of the cooling medium, all of which could have been saved if proper care had been shown. Hourly temperature readings are the best indications of anything wrong in this direction. In case the circulation has been stopped by any cause, the transformer may be operated until the coils at the top of the transformer, in the case of an air-blast, or the oil, in the case of a water-cooled transformer, reach an actual temperature of eighty degrees centigrade. This temperature limit, under ordinary conditions, will permit the transformer to continue delivering power for about three hours; a very close watch must be kept of the temperature, and the transformer must be taken out of service as soon as it reaches this limit.

In the operation of transformers the delta connection has an advantage. With one grounded conductor the service need not be interrupted, except perhaps if the ground is an arcing one, which might set up continuous high-frequency surges, producing high-voltage stresses on the transformers in circuit. Comparisons of different systems are shown in Table III, which are representative of practically all the most modern high-voltage transformer installations in the world. There are one or two of equal importance under construction.

TABLE III.—MODERN HIGH-VOLTAGE POWER TRANSFORMERS OPERATING ABOVE 62,000 VOLTS.

Systems.	Kilowatt capacity.	Voltage of line.	Connection of system.	Phase.*
Stanislaus Power Co.	3,750	138,500	Star	1
	2,233	104,000	Star	1
Great Western Power Co.	10,000	110,000	Delta	3
	5,000	90,000	Delta	1
Grand Rapids-Muskegon Power Co.	3,750	110,000	Delta	3
Hydro-Electric Power Commission	1,250	110,000	Delta	1
Great Falls Power Co.	1,200	102,000	Delta	1
Central Colorado Power Co.	3,330	100,000	Delta	1
Southern Power Co.	3,000	100,000	Delta	1
Mexican Light & Power Co.	6,000	85,000	Star	1
Telluride Power Co.	1,500	80,000	Star	1
Southern California Edison Co.	1,660	75,000	Star	1
Pennsylvania Water & Power Co.	10,000	70,000	Star	3
Missouri River Power Co.	1,500	70,000	Star	1
Southern Wisconsin Power Co.	1,000	70,000	Delta	1
Connecticut River Power Co.	5,000	66,000	Star	3
High Falls Development	1,100	66,000	Star	1
Canadian Niagara Falls Power Co.	1,250	62,500	Star	1

*This refers to the type of transformer, whether single-phase or three-phase.

From the standpoint of the operating engineer (neglecting all losses) the single-phase transformer is at the present time preferable where only one group of transformers is installed and the expense of a spare transformer would not be warranted, as in the delta-delta connected system. If one of the three transformers should become damaged it can be cut out with a minimum amount of trouble, and the other two can be operated at normal temperature on open delta at approximately fifty-eight per cent of the total capacity of the three. With a three-phase transformer a damaged phase would cause considerable inconvenience, for the whole transformer would have to be disconnected before repairs could be made.

Apart from the decrease in manufacturing cost with increase in size of units, the three-phase transformer possesses the advantage of requiring less material, and is more efficient than any other single-phase combination of transformers of the same kilowatt capacity; three single-phase transformers weigh seventeen per cent more than, and have seventeen per cent more losses than one three-phase transformer.

Where a large number of three-phase transformers is installed in one building, say, three groups or more, there is unquestionably a great saving over any combination of single-phase units.

The relative advantages of the delta-delta and delta-star systems are still disputed, and are open to discussion. From the point of view of first cost, the delta-star is unquestionably the better. The question will be largely governed by local conditions, and no definite system of connections can be given to suit all cases.

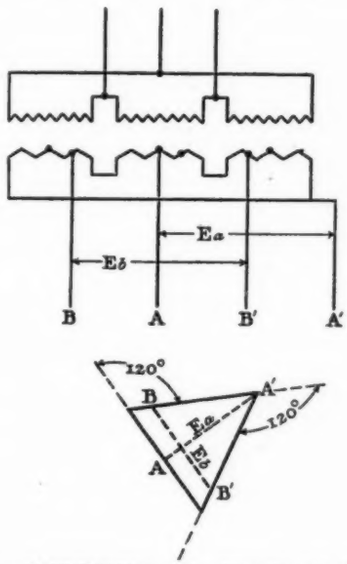
Whichever scheme of connections is decided upon, it will be always found advisable to keep to that scheme throughout the system; otherwise complications might result. This is particularly applicable on some of the larger systems of 100 megawatts and over, where networks of high-voltage transmission lines and substations are numerous.

Larger power transformers operating high-voltage transmission lines should be protected against excessive currents, and also against excessive voltage above normal. Some protective apparatus or device should be used, even if it is only an overload device. Protection should be given against external and internal short-circuits, such that the transformer will be disconnected in case of an internal short-circuit, and that section of the transformer system relieved from any external short-circuit. For external short-circuits the external reactance is being favorably considered in limiting the flow of current. To get absolute protection of a system of transformers from internal and external causes is difficult, and in some cases impossible.

The more we centralize electric power systems the more we shall require the three-phase, two-phase method of distribution, which will come about through the transformation from three-phase high-voltage transmission.

It is well recognized that any combination of the two-transformer method requiring a change from three-phase to two-phase, or from two-phase to three-phase, is made at the expense of regulation, as well as involving a loss in efficiency. If the connection is used to step up from two to three-phase, similar connections should be arranged for stepping down at the receiving end; in this way the possibility of cross currents or asymmetry will be avoided.

Continuity of service is now one of the main factors to be aimed at, and the three-transformer method shown in the diagram is in some respects superior to the two-transformer method. If one of the transformers in the three-transformer system should become damaged, making it inoperative, the two remaining transformers may be, in a very short space of time, temporarily connected in open delta and service continued until the other is repaired, thus avoiding the necessity of carrying a spare transformer in stock. And if a transformer is kept in stock, its kilowatt rating need only be approximately sixty-seven per cent as great as that of a spare transformer for the two-transformer system. This system was only applied to practical city distribution a short time ago, and it is surprising what great strides have been made. It also claims the advantage of supplying both three-phase and two-phase currents to a secondary distribution of four wires, this being a special advantage in cities where there already exist two or more electric power companies operating both two and three-phase systems,



"T" CONNECTION OF THREE TRANSFORMERS.

as no transformers are required for connecting either a three-phase or a two-phase motor. From the point of view of reliability of operation the three-transformer system has far greater advantages than the two-transformer system.

It is feared by some transmission engineers that the high-voltage transformer will again become the limiting feature of high-voltage transmission because of the internal effect due to corona. This effect so far has not been very noticeable, but as line voltages are increased above present-day practice (110,000 volts) certain effects due to this discharge may arise which may radically change the present methods of design in high-voltage transformers. Whenever possible, transmission engineers recommend switching-in first the transformers at the far end of the line and afterwards the transformers at the generating end.

With the large systems now being operated, consisting of 100 to 150 megawatts in generator and transformer capacity, and hundreds of miles of transmission lines supplying thousands of customers of all classes, maintenance of a very high degree of reliability is the principal problem of the engineer. The question now before us is that of limiting the amount of energy which can flow into a fault or short-circuit, and the only real practical solution applied so far is the use of reactance, which is the enemy to voltage regulation.

Loss in Coal Due to Storage.

In a recent article in a chemical journal A. Bement, of Chicago, gives the results of experiments to ascertain the losses in Illinois coal incurred by storage both exposed and submerged. In these experiments it was endeavored to find the change in heating power, change in weight, and tendency to disintegrate by slacking.

Springfield coal showed a loss in heating power of 0.93 per cent and loss in weight of 1.15 per cent; central-seam coal showed 1.85 per cent loss in heating power and 2.29 per cent loss in weight; southern-seam coal showed 0.38 per cent loss in heat-value and 0.11 per cent gain in weight. Southern-seam coal retained 87.84 per cent in lump form, Springfield coal 35.49 per cent, and central-seam coal 18.36 per cent. Stored under water, central seam lost 0.44 per cent in heat value and 0.35 per cent in weight; southern-seam coal gained 0.02 per cent in heat value and lost 0.81 per cent in weight. All tests were for a period of one year.

Increased Use of Fuel Oils.

The use of fuel oils is steadily increasing. Railroads consumed 24,586,108 barrels in 1910, against 19,939,394 barrels in 1909. The advantages of oil over coal have been clearly recognized by the United States Navy, and in new construction fuel-oil burners are being more and more extensively used.

United States Leads in Oil.

The United States is now by far the greatest oil-producing country; in fact, it produces more than all the rest of the world together. In 1910 the wells of this country yielded nearly 64 per cent of the total production.

Commercial Practice—Management, Rates, New Business.

Less Shrinkage of Meats When Cooked by Electricity.

Commenting on the demonstrations which were given at the recent London Electrical Exhibition in electric cooking several times daily by representative firms, a consular report states that in view of the fact that electricity for this purpose and for heating can now be obtained at a low cost, the increased interest taken in and the greater activity among makers in advertising the advantages of this method of cooking can be more readily understood. In the case of one system, which consisted of a series of hot plates on flexible armored wire, it was claimed that there was a saving of $90 on a yearly expenditure of $415 under the old style. In addition to the economy in coal, there was a remarkable saving effected in the shrinkage of meats, as evidenced by the following table:

Meats	Weight		Weight when cooked		Type of oven	Loss	
	lb.	oz.	lb.	oz.		lb.	oz.
Leg of mutton..	8	8	5	13	Coal	2	11
Do	8	4	6	0	Gas	2	4
Do	9	0	7	12	Electricity	1	4
Shoulder mutton	6	13	5	1	Coal	1	12
Do	5	10	5	0	Electricity		10
Topside of beef	5	4	3	6	Coal	1	10
Do	4	0	3	8	Electricity		8

There were several model kitchens shown in operation, and rivalry in this direction appears to be growing very keen.

Among the newest applications of electricity to cooking and heating is the quartzalite system. In this appliance the heating element consists of spiral wires of special alloy, inclosed in a quartz tube. When heated, the quartz becomes transparent and can not be melted except by an electric furnace. When the current is switched on, the wires are raised in temperature to a bright red heat, and as the tubes do not wear out the cost of maintenance is low, the wire spirals only needing renewal at long intervals.

Warren to Have Slogan Sign.

Warren, Ohio, where are located a number of big electrical concerns, is to have a slogan sign 60 by 40 feet in size. The Trumbull Public Service Company, a new Doherty property, is to erect the sign and supply the current.

The Board of Trade of Warren has offered a gold medal to the person submitting the best motto for the city. This motto is to be displayed on the sign.

Ornamental Street-Lighting Negotiations in Rochester.

The Rochester (N. Y.) Chamber of Commerce is at the present time considering the subject of ornamental street lighting for Main Street, the principal business thoroughfare of the city. Several plans have been proposed, those receiving the greatest attention being tungsten posts and magnetite arcs. Although no official decision has as yet been made it is thought that the system employing magnetite arcs will be adopted.

A tentative design for the magnetite

PROPOSED "CONVERTED" POST FOR ROCHESTER.

post has been made and is reproduced herewith. It will be seen that it is the intention to convert the present trolley poles into ornamental poles by the addition of a suitable bracket. The post is designed round with a square connection at the point where the arms extend. This square feature makes it possible to have two other arms extend at the intersection of streets where four lights are desired. The post is 20.5 feet in height at the point where the trolley support connects and 17.5 feet at a point about the center of the lamp.

The Rochester Railway & Light Company, being asked to report on the cost of the various systems proposed, submitted to the Chamber of Commerce the following:

MAIN STREET LIGHTING.

	Present Arcs	Magnetite Arcs	Tungsten Posts
Number	132.*	214.*	237.
Average distance apart, poles.....	161.	100.	45.
Cost per lamp or post	62.96	85.78	90.00
Relative Illuminating Value per Arc & Tungsten Post (approx.)	1.	6.5	1.6
Relative effective illumination on street (approx.)..	1.	9.	1.6
Annual cost—			
Total	$8.310.00	$18.560.00	$21.330.00
Per running foot	1.56	3.50	4.00
Per ft. frontage..	.93	2.07	2.38

*As arranged without Tungsten posts now installed.

The report covers the lighting of Main Street from Caledonia Avenue to Scio Street, a distance of 5,325 lineal feet, or 8,968 feet frontage of property, exclusive of streets and alleys.

Attractive Holiday Literature at Low Cost.

The General Electric Company has prepared two very attractive pieces of literature—a booklet and post card—designed to assist central stations in the sale of Edison miniature decorative lamps and Edison outfits during the holiday season.

This literature, printed in the natural colors of the lamps, presents an attractive appearance and should serve as a first-class opener in introducing Christmas-tree lamps and outfits. It is supplied with the imprint of the central station. A small charge is made.

Electrically Heated Bakers' Ovens Loaned by Central Station.

According to the *Elektrotechnische Zeitschrift*, the municipal electricity works of Vienna, Austria, has offered to place electrically heated ovens at the disposal of members of the Bakers' Association of that city free of charge, and to guarantee that their use will not entail any increase in the working costs. The experiment is being made to demonstrate the advantages of electric heating for this purpose, foremost among which are cleanliness, evenness and certainty of baking, etc.

Washington Company Co-operates with Merchants.

The Washington Railway & Electric Company, of Washington, D. C., has agreed to co-operate with the Retail Merchants' Association in stimulating early Christmas shopping by carrying card signs on the front of its cars, bearing the words, "Christmas Shopping—Do it now."

Status of the Electric-Sign Business in Rochester.

That the merchants of Rochester are realizing the advertising afforded by the electric sign is indicated by the large number of installations and by the exceptionally high character of the signs. An unofficial count made by L. W. Layman, manager of the sign department for the Rochester Railway & Light Company, on October 26, showed a total of 246 sign installations, using 34,217 incandescent lamps and representing a connected load of 676,550 watts. This number has now been considerably increased as the company reports remarkable progress in the number of installations made since the above date. The accompanying illustration shows a few of the signs installed on Main Street.

MAIN STREET, ROCHESTER, AT NIGHT.

All recent signs and many older ones are equipped with Mazda lamps.

The Northern California Power Company, to encourage the use of electric energy in the Sacramento Valley, Cal., has issued a circular letter, through its president, H. H. Noble, to all dealers in electric vehicles, offering to supply free power until 1913 for all electric automobiles owned and operated in that territory.

New Rates Proposed for Birmingham.

In compliance with a city ordinance proposed to reduce the prices of electricity both to the city and general consumers, the Birmingham Railway, Light & Power Company, Birmingham, Ala., has published the following schedule of rates which if accepted will become effective April 1, 1912:

For street lighting the city will pay the company monthly at the rate of $5.21 per month for each arc light installed, maintained and illuminated, as agreed by the company, being at the rate of $62.50 per annum, and $2 per month for each series tungsten lamp installed, maintained and illuminated, as agreed by the company, being at the rate of $24 per annum. The present rate for arcs is $70 per annum and for sixty-candlepower series tungstens, $28 per annum.

The schedule of rates for residence lighting is as follows:

Ten cents per kilowatt-hour for all electricity supplied to regular customers in every month up to and including a consumption equal to thirty hours' use of the consumers' connected load in such month; and seven cents per kilowatt-hour for all electricity supplied in any one month in excess of such consumption, the minimum monthly bill for each installation to be $1.10. Bills will be rendered monthly (except in cases otherwise provided by special contract) and a discount of five per cent will be allowed on that portion of the bill equal to a consumption of the first thirty hours' use of the connected load, or on the minimum monthly bill, as the case may be, if the bill is paid on or before ten days after it is rendered. The following additional discounts will be allowed on the monthly consumption in excess of the first thirty hours' use of the connected load:

From	0	to	25 K. W. H.,	10 per cent.
From	25	to	150 K. W. H.,	15 per cent.
From	150	to	250 K. W. H.,	20 per cent.
From	250	to	400 K. W. H.,	25 per cent.
From	400	to	500 K. W. H.,	30 per cent.
From	500	to	1000 K. W. H.,	35 per cent.
From	1000	to	1500 K. W. H.,	37½ per cent.
From	1500	to	2000 K. W. H.,	40 per cent.
From	2000	to	2500 K. W. H.,	42½ per cent.
From	2500	to	3000 K. W. H.,	45 per cent.
From	3000	to	3500 K. W. H.,	47½ per cent.
Amounts over 3500 K. W. H.,				50 per cent.

The present lighting rate in Birmingham is twelve cents per kilowatt-hour with a minimum monthly charge of $1.25.

Residence-Business Committee of the Commercial Section N. E. L. A. Meets.

A meeting of the Residence-Business Committee of the Commercial Section, National Electric Light Association, was held on November 27, at the office of the chairman, to organize and discuss plans for the year's work. Those composing the committee are J. F. Becker of New York city, chairman; N. H. Boynton of Cleveland, secretary; S. M. Kennedy of Los Angeles, Cal., G. B. Griffin of East Pittsburg, Pa., F. H. Gale of Schenectady, N. Y., E. A. Norman of New York city, G. C. Osborne of Harrison, N. J., and F. D. Pembleton of Newark, N. J.

Objectionable Sign Ordinance in Altoona Repealed.

The ordinance in Altoona, Pa., prohibiting the erection of signs over the sidewalk has been repealed and in its place is a new ordinance which makes possible a great "White Way" in that city.

The merchants are hurrying to put up signs, and it is estimated that a hundred and fifty new electric signs will be installed in Altoona before Christmas.

The Penn Central Light & Power Company reports excellent sign business as a result of this move.

Electric Lighting and Illuminating Engineering

THE ARTIFICIAL LIGHTING OF HOSPITALS.[1]

BY JOHN DARCH.

No one who has had any insight whatever into the work of modern hospitals could do otherwise than feel the greatest admiration for the splendid service and effective equipment that characterize those institutions; and yet it must be said that, models of elegance and hygienic forethought as they are, their excellence is usually marred by the engrafting thereon of systems of artificial lighting that would justify a repetition of Miss Nightingale's trenchant observation that "the very first requirement in a hospital is that it should do the sick no harm."

In visiting the principal London and other hospitals I have been keenly struck with the universal want of discrimination in lighting; there is a kind of trade orthodoxy which cherishes certain forms and fittings, and decrees their use often in defiance of common sense. Take, for example, the ubiquitous plain ten-inch opal-shade pendant that does duty with equal impertinency in ward, kitchen, operating theater, corridor, and consulting room. It would be difficult to find a more irrational, inefficient, and indefensible fitting for most of the purposes to which it is applied, while it can hardly lay claim to be a thing of beauty. The shade affords no protection to the eyes of patients or nurses against the sting of the glowing filament, and from the fact that thousands of cardboard "eye-screens" have been sold to patch up this so-called "shade" for the necessary protection of the eyes of the healthy and vigorous in office and shop, it must be obvious that it is unsuited to a hospital. Again, the shade darkens the ceiling, and, by preventing reflection from its large white surface, practically darkens the room.

Another token of orthodoxy is the swan-neck bracket, which, with its popular form of "shade" that shades nothing, and its bare light, has been described as "nothing less than an instrument of torture." In some hospital wards the brackets have been mercifully placed lower and closer to the walls. Much more might be said to show the need of reform.

It is not so much a question of gas versus electricity or any other illuminant as that of the art of illumination which regulates the arrangement of the lighting units after they are brought into the room. I do not propose, therefore, to enter into a comparison of the merits of the various lighting media, although some plain statements from one unbiased by any of the conflicting commercial interests might prove useful. I will only say that whether electricity, coal gas, acetylene, petrol-air gas, or even oil lamps be employed, it should be possible to successfully illuminate every department of a hospital with either.

Light (and in that term radiation both visible and invisible must be included), like any other form of energy, may become an agent of destruction or a minister of health and blessing precisely in accordance with the wisdom shown in its application. It is the duty of the professional adviser, be he architect or engineer, to understand all that pertains thereto before he can pretend to satisfactorily invest his buildings with the instruments of such a force.

There are to be avoided, on the one hand, the evils of glare, and particularly that which, in a ward patient, would enter the lower part of the eye; the evils of excessive brilliancy, of violent contrasts of light and shade, and of the injurious and troublesome rays of heat and actinism; there is also to be avoided the risk of eye strain consequent upon insufficient light or upon the effort to see in the face of misplaced lights. On the other hand, there is to be sought the comfort of a soft and well diffused light so arranged that vision may be both easy and pleasant, which after all, is the proper object of lighting.

The value of illumination depends not on the amount of light that is shed throughout a room, but on that which is reflected from visible objects. An essential part, therefore, of any scheme of illumination is the coloring of walls and ceilings, the strength of which must be properly balanced with the amount of light available. Dark colors eat up the light, and are, therefore, wasteful. White ceilings, cornices and friezes not glossy, with pale tinted walls and slightly darker dados, will best serve the hospital and its inmates.

Let us proceed to consider some practical methods of dealing with the subject.

The Hospital Ward.—The average ward unit—of, say, twenty beds—should be provided with two kinds of illumination (1) general, and (2) local.

1. The general lighting need be no more than enough to see clearly about the room, say, 0.5 foot-candle.

No sources of light, nor any illuminated surfaces exceeding 0.1 candlepower per square inch (14 candlepower per square foot) should be exposed to the patients' or nurses' eyes; whereas the intrinsic brilliancy of the

Gas mantle averages	30	c.p.	per	squ. inch.
Acetylene flame	40	"	"	"
Electric carbon filament	400	"	"	"
Electric metallic filament	1,000	"	"	"

Direct illumination, therefore, useful enough in the lofty out-patients' hall or elsewhere, is quite unsuited to a hospital ward.

Direct lighting lamps may, however, be used if provided with proper shades, but everything depends upon that word "proper." Glass shades and all transparencies are inadmissible, nor should any partial translucency exceed the above named limit of brightness, while any shade that is used should effectually screen the eyes without materially darkening the room. If bracket lights are used for general lighting, a half-circle shade should be used so as to iluminate the wall. The practical result of all this is a soft all-over illumination which is very pleasing.

High-placed ceiling lights will prove equally successful with a carefully calculated shading.

Indirect lighting by means of the inverted electric arc is deservedly gaining favor, but although it would serve well in many parts of a hospital, I could not recommend it for the ward, as the ceiling would be too dazzling for those who have to lie on their backs.

1 Abstract of a paper read at the Congress of the Royal Sanitary Institute, Belfast, Ireland.

A happy effect may, however, be obtained from indirect lighting with tungsten or other metallic-filament lamps placed inside a shallow metal bowl, white on the inside. To obtain the best effect they should be hung as low as convenient, nor should the lamp be set too low in the bowl.

Excepting in the winter, artificial lighting is little needed in the ward, for hospital economy favors very early hours, but some sort of subdued lighting is necessary during the night watch all the year round. With gas or acetylene a small burner, shaded, on a by-pass would do. In electric lighting, several expedients have been adopted, but a two-candlepower shaded lamp is the most economical. An excellent arrangement is indirect lighting from an eight-candlepower lamp in a small bowl. This is employed, for night purposes only, at Tooting Bec Asylum.

2. The nurses' tables should each have a well shaded lamp, that is adjustable in height, so that any desired intensity may be obtained. A comfortable illumination for reading is four foot-candles, but ten foot-candles is not too much for some purposes. A good form of shade is a deep cone of dark green opal, with the lamp entirely recessed. A more cheerful form would be one with a rose silk flounce with white lining, deep enough to hide the lamp, and for cleanliness the top should be of white opal glass, and the flounce easily removable.

The patients' lights are best placed one at the head of each bed, hidden in a dark-green opal shade and somewhat to the left, so as not to radiate heat on the patient's head, and to avoid gloss in reading. An illumination of four foot-candles should be available. This lamp will be useful for examination, and should illuminate the patient's chart. Near this there should be a plug for a hand or stand lamp.

If gas is the lighting medium, a "bijou" inverted mantle similarly shaded would be suitable for both patients and nurses. If acetylene, a small flame burner.

Steadiness is an essential condition of good sanitary illumination, for fluctuation and flicker are not only very disturbing, but may cause a permanent injury. This trouble may arise (*a*) from the glow lamp when used on an alternating current whose frequencies are below, say, thirty-five per second; (*b*) from an arc lamp when the light varies in intensity and color, due to unsuitable or impure carbons, or when it "pumps," due to defective feed mechanism; (*c*) from the gas mantle, due to an ill-regulated air supply, accumulated condensation in pipes or the wind from the open windows of the ward; and (*d*) from all flame burners by the two last mentioned causes.

Gloss is frequently as troublesome as bare lights, and yet the majority of hospital wards have shiny ceilings. There should be no difficulty in getting a diffusive or dead surface as sanitary as that of the objectionable glossy one.

The Operating Theater.—The operating room or theater needs good artificial light, and plenty of it, for there is a large proportion of surgical work done after dark. It should have a separate general illumination with screened lamps over the sinks and sterilizers. The ceilings and walls should be completely reflective, and are best lined with close-jointed white glazed tiles or opalite, with a little relief in the form of a pale green or gray dado.

The illumination of the operating table is, of course, the leading consideration. The light should approximate to the color, the perfect diffusion and the high intensity of broad daylight; both the nuisance of overhead heat and the septic risks of dust collection should be avoided, and the fittings and glass employed should be plain, smooth and easily cleansable.

It is important that the lights should not all be clustered together, forming deep and troublesome shadows, nor be situated directly over the table to worry the surgeon with the shadows of his own head and hands, or that would necessitate the frequent shifting of the table. Yet these are the arrangements most commonly met with.

Every hospital has its own pattern of operating light (scarcely two are alike), while many of them are very curiously contrived. The following may be taken as typical of the more usual arrangements:

1. One or more plain shade pendants of the common type, sometimes with a dust-raising counterweight and pulley.

2. A cluster of from two to twenty glow lamps under a large opal shade.

3. Rectangular trough four feet long with opal sides, full of lamps, and sometimes with a sheet of opal glass underneath; this gives an excellent light, but the heat is intolerable.

4. A four or six-light electrolier, each arm with a separate lamp and opal or aluminum bell shades.

Either of the foregoing may depend from the ceiling or from the end of long swing brackets. Glow lamps should have metallic filaments; tungsten is said to give the whitest light. Gas burners are sometimes attached.

At Charing Cross the drawback of concentration is well met by distributing the light over the long arms of four brackets and round the gallery front.

The London Hospital and that at Ryde are fitted with Marshall's operating light, consisting of a fixed central 100-candlepower lamp under an opal reflector, with four hinged arms, each with a 60-candlepower Nernst lamp in a condenser tube projecting the light to any desired spot.

Electric arc lamps are employed in some Continental operating theaters.

Direct lighting with ordinary arc lamps is out of the question on account of the unavoidable shadows; excepting, perhaps, for general lighting. But where there is a large skylight a splendid direct illumination may be obtained from white flame-arc lamps, which have a remarkably high efficiency, and throw most of their light downwards. Four of these may be suspended over, but not too close to the ceiling light, which should be of clear fluted glass to spread the light. They may be fixed, or may move on rollers worked by cords in the room. Questions of dust and the intrusion of lamp trimmers are thus eliminated.

Indirect arc lighting, particularly where there is no skylight, is eminently suitable. Four ten-ampere open arcs, properly placed and reflecting directly against a white ceiling, would give a brilliant illumination, with all the advantages of daylight.

Professor Siedentopf has invented an ingenious arrangement for lighting the operating table by means of isolated beams of light, which are not only ample but entirely eliminate the dust question.

There are two forms of it:

(1) The single, in which a twenty-ampere projector, or search light, is placed outside the theater, and about seven feet six inches high, from which a parallel beam of light is directed through a hole to a small mirror, thence to the table, or through a second mirror to the table. This beam is controlled by an iris diaphragm and smoked glass. It is best suited to the gynecological and

throat theaters. It is necessary to have good general lighting.

(2) The compound form is more satisfactory. A projector lamp as before, but of twenty-five to thirty amperes, directs the light through an aperture to a thin metal disk, on which are placed small distributing mirrors which divide the main beam into a number of smaller ones, and which are separately projected to receiving mirrors placed around the room. These mirrors reunite the light on the table in a many-sided form, free from shadows.

Electric fuse wires have a knack of "going" at most inopportune moments, while a breakdown on the part of a supply company is not unknown. It is, therefore, essential to have a reserve for such an emergency. The fusing trouble is more common on branch circuits; one excellent precaution, therefore, will be found in wiring glow-lamp fittings from two separate main branches, either of which failing, enough light may be left to work by.

To provide against failures on the main there are two methods:

(1) A gas lamp with an inverted mantle, as at the West London Hospital, which should be lit during operations.

(2) An electric accumulator, from which a small emergency lamp should be kept alight during operations, and in connection with which it should be possible to immediately switch on sufficient light from the accumulator to complete an operation. Separate lamps would be required for this purpose unless it would be convenient to have the voltage of the accumulator equal to that of the circuit.

Some hospitals keep oil lamps ready at hand.

Hand and stand electric lamps of a variety of patterns are to be found in every operating theater.

The Dispensary is usually the worst served of any department. It is, in London, frequently to be found in the basement or in some other part of the building lacking daylight, while the artificial illumination is commonly so inadequate that it sometimes becomes a difficulty and a worry to read the prescriptions. Many of the bottles abide in gloom, while the poison cupboard, which with its small bottles needs a particularly good light, often fares no better. Happily, the busy dispenser acquires habits of caution, and mistakes are rare, but when a dispensary has to make up from anything to 500 bottles of medicine daily, it is surely worth the cost of better lighting to minimize the risk, to say nothing of avoiding injury to the eyes of the dispenser.

A properly shaded light yielding four or five foot-candles is required to each man on the dispensing benches. The shelves should be illuminated with screened lights to facilitate visual acuity; in fact, no bare lights should be visible. Undoubtedly, the inverted arc lamp with a white ceiling would afford the best illumination, while the operating cost of it should compare favorably with that of glow lamps.

Where is the dispensary or laboratory that provides facilities for reading the graduated measuring glasses? Nothing is more productive of eye strain than the effort to decipher any kind of graduated scale, but with the faint lines of a glass measure in the twilight of the average dispensary held up to a patchwork background of bottles the strain is increased. It would save time and afford comfort if small white screens were fitted up, one in front of each man, adjusted to catch the chief incident rays from a skylight or window at such an angle that they are reflected towards the dispenser. The same screen could be used under an artificial light or in a permanently dark situation, or there should be an illuminated panel of either reflected or transmitted light.

The commercial mind has realized that the health of the worker is the wealth of the employer, and that the extra cost of better illumination is repaid a hundredfold in time saved and better work produced.

I have dealt only with the three characteristic departments of hospital service, and regret that space has failed me to treat of such equally needy subjects as the proper illumination of sight-testing types, the lighting of the consulting room, the out-patients' departments, the corridors, staircases, and general service rooms, but I trust that sufficient has been said to demonstrate the need for reform and the direction it should take.

The Southern Pacific Railroad Company is installing automatic electric-lighting devices in all its tunnels to reduce the number of accidents. The lights operate when the train is within about 100 feet of the tunnel, warning pedestrians and affording light for the engineer.

Nearly 10,000 Members in National Electric Light Association.

At the present moment the records of the National Electric Light Association show an actual membership of very nearly 10,000 members. As of November 21, the actual list is 9,894 members. The membership as of that date stands as follows: 978 Class A; 7,706 Class B; 41 Class C; 240 Class D; 929 Class E. H. H. Scott, chairman of the Membership Committee, or, as it is now known, the Committee on Organization of the Industry, has just returned from a vacation trip to Europe, and, with wonted energy, is now lining up his associates for the new campaign of 1912.

Flaming Arcs on Main Street in Council Bluffs.

The central-station company at Council Bluffs, Iowa, has installed flaming arc lamps along Main Street from Sixth Avenue to Sixteenth Avenue. General satisfaction has been expressed at the change from the old arc lamps.

Ornamental Street Lighting in Haverhill.

A strong movement is under way by the business men of Haverhill, Mass., to put in an ornamental street-lighting installation along some of the principal business streets. Four sixty-watt tungsten lamps are to be placed on brackets on each of the ninety trolley poles in the district. The Haverhill Electric Company has offered to put in and operate the installation for $70 per pole per year under a two-year contract.

Trade-Marks in Argentine Republic.

Under the existing law in Argentine Republic it has been customary for local importers to register the trade-mark used by foreign manufacturers of goods so that when these manufacturers attempt to introduce their products into that country they are unable to make use of the trade-mark without first paying for permission from the legal proprietor thereof.

A recent court decision in that country, however, makes it possible for the originators of said trade-marks to secure official recognition of their right to the use of the same by proof of priority, and it is thus made possible for manufacturers to export their goods to these countries and sell them under established trade-marks without submitting to blackmail.

Telephony · Telegraphy and Wireless

RATIONAL TELEPHONE RATES—I.

BY FRANK F. FOWLE.

At this time the subject of telephone rates is attracting an increasing amount of attention, largely because of the rapid spread of the theory of government regulation of public-utility rates. The last decade has witnessed a rapid reversion from obsolete to modern theories in rate making. Fundamentally this change in public sentiment comprises an abandonment of the value-of-service theory in favor of the cost-of-service theory. The latter carried to its logical conclusions forbids discrimination in any form, not only between different classes of consumers, but as well between different consumers in any one class. An adequate degree of publicity in the corporate affairs of public-service companies is a further measure which seems to have the benefits of increasing public enlightenment on the nature of public-utility enterprises and bringing the companies into much more harmonious relations with their consumers and the public at large. Suffice it to say that the modern theory or regulation, as applied to central-station, gas, water and telephone companies, is now seldom resisted by the companies themselves when applied with fairness and intelligence. Proper regulation recognizes that privileges and obligations are mutual to both parties at interest, and that on behalf of the companies a restriction of profits to a reasonable amount should be compensated by safeguards to insure a return of no less than a reasonable amount, under economical management.

Rate making as an art is much further advanced in the case of central-station service than in telephone service. A variety of reasons may be assigned to explain this situation, prominent among which are the wide diversity in competition and control of central-station companies and the peculiar commercial conditions which have surrounded the telephone industry from the start. Central-station problems have been widely and freely discussed by the engineering profession, and in consequence have received much attention. The same freedom of discussion has not taken place in relation to telephone practice, and the art has undoubtedly suffered in some respects as a consequence. Particularly in the matter of scientific rate making, on a cost-of-service basis, the telephone companies as a whole are lagging somewhat with reference to their contemporaries in public service.

The problem of telephone rate making has been approached therefore with an unusual degree of caution by rate-making bodies and their advisers. Strong outside influences toward a scientific study of such rates have been notably lacking until quite recently. And in many instances those who have undertaken such studies have not had the advantage of thoroughly understanding the fundamental principles now well established in making central-station rates. The field is yet comparatively new and therefore of much interest. A review of the situation up to this time and some proposals for a more rational rate basis do not seem therefore to be out of order.

Flat rates now undoubtedly persist to a greater extent in telephone service than in public service of any other kind. The reason is not far to seek. Such rates were employed at the outset in public service of almost every kind and in telephone service in particular. The value-of-service theory then dominated all rate making. The early introduction of different flat rates for different classes of telephone service was quite in line with that theory and had for its object the stimulation of telephone use and development. The matter of discrimination received little attention at that time and if recognized at all was regarded as wholly justifiable when it increased the business without impairing the rate of profit as a whole. The conditions which arose later to modify the rate theories then held were somewhat dissimilar, in the case of telephone service, from those that caused the abandonment of flat rates for electric lighting and motor service.

Flat rates for telephone service were apparently successful from an operating standpoint before the development entered its period of remarkable growth, prior to about 1895. The companies prospered financially, for the most part, and there was no seeming obstacle to future expansion or success. But the growth of individual exchanges to considerable proportions, a phase of development which arrived soon after the date just mentioned, brought prominently to the front a condition not foreseen and one which commenced to affect the quality of service in a serious way. The well known fact that flat rates do not in any way restrict the needless use of the service, or prevent waste, was then receiving some recognition, but it was found that in telephone service the evils of this character were present in double degree, or compounded, so to speak. Not only did individual subscribers sometimes use their lines to excess, but at the same time they made it impossible for others wishing to call them to obtain connection. The proportion of calls not completed because of busy lines was found to be increasing, and with it a large waste of operating labor that otherwise would have been saved.

Thus it was clearly developed that the quality of telephone service was affected by factors beyond the company's control under a flat-rate system. The harmful effects of individual waste or abuse were not confined, as in the case of central-station service, to the direct or immediate burden on the company, but were multiplied; not only did they affect the service of others, but they imposed thereby a further burden on the company. Obviously there was need of a rate system which would check the tendency to excessive and unnecessary use of subscribers' lines. The net result was the development of the measured-rate system, basing the charge on the quantity of service or number of outgoing messages, with a minimum charge or guarantee.

It would be improper to pass over another influence of great importance which stimulated the proposal for measured rates. Any system of flat rates must be based as a whole on average use, or on class averages, if made as

nearly equitable as such a principle permits. Considering that class which bears the lowest rate, the average (flat) charge is too high for some consumers and too low for others, in view of their needs. Obviously a flat charge cannot fit all conditions equitably and must, of necessity, suppress much business which cannot bear a rate as high as the average. Taking all the consumers of a public-service company and grouping them by classes according to consumption or use, in descending order, it will be true as a rule that each class outnumbers the one just preceding it. That is, small users are greatest in point of numbers and comprise a large proportion of the development; and their needs, as a whole, are more nearly characteristic of the community than those of any other class. Hence it becomes essential to serve them to the greatest extent consistent with a reasonable profit.

Quite obviously a measured or meter rate meets this situation more effectively than a flat rate. This is true regardless of the extent of the exchange area or zone, but it bears with most weight upon the situations in large cities, as contrasted with small cities or towns. This brings us to the explanation of a fact that is not as well understood as it ought to be, and one which has been distorted in some instances. The cost of telephone service rests as a whole upon three factors, namely, the area of the exchange zone, the type of construction and equipment and the number of subscribers. Comparing with each other two exchange zones of unequal size, but like construction and equal numbers of subscribers, it is fundamentally true that the cost of service will be greatest in the larger zone. Or otherwise stated, if any particular exchange zone be considered, whose area is imagined to be expanded or contracted at will without disturbing any part of the plant except the distribution system, the rates for service will increase with the area of the zone, assuming a constant rate of profit. The reason for this is almost obvious. Considerably more than half the total investment is in the distribution system or outside plant, and the average number of miles of wire per line or per subscriber increases with the zone area, so that the investment and maintenance charges increase correspondingly.

A counter influence on the increasing service costs in expanding zones is rising development, which tends to reduce the costs again, on a per-line or per-station basis. As finally stated, the cost of service increases with expanding zones and decreases with rising density of development, under like conditions as to plant. This explains why rates for equal service are higher as a whole in cities than in towns; the exchange zones in the former are much larger as a rule than in the latter. A secondary reason lies in the greater proportion of lines underground in the first case, and a third factor enters in the rising cost per line for central-office equipments as the number of lines increases. The last element has sometimes been overemphasized to explain seemingly high rates; but furthermore, the subdivision of the exchange zone into two or more central-office districts has an important bearing on the question. There is not space here to discuss these elements elaborately, but enough has been advanced to clear up some of the more important features. The proposition that rates fall with rising density of development, assuming a constant area of exchange zone, is pretty well proved by the general history of rates in the larger cities; the downward tendency almost since the beginning is well known.

Returning to the question of measured versus flat rates in its relation to development, it should be apparent without more discussion that the companies operating in the largest cities found it imperatively necessary to adopt measured rates in order to reach the small user on a profitable basis. Rates of this kind are much more prevalent in cities of considerable size than elsewhere. In the smaller cities and towns there has not been the economic pressure to abandon flat rates, so as to secure a large development by reaching small users, that has just been dwelt upon. It does not follow that flat rates are equitable or non-discriminatory in the smaller exchanges; there is no satisfactory defense of such rates from a scientific or an ethical standpoint under the cost-of-service theory, with one possible exception. The latter concerns rural or farmers' lines, where the cost of meter reading and monthly collections might offset any advantages, and where again there is some inherent difficulty in applying a measured-rate system on heavily loaded party lines without center checking.

Flat rates are now understood to give rise to other evils or disadvantages; some of which are deduced by analogy from studies of central-station consumption and demand. The maximum collective demand for service, or the peak of the station load, fixes the necessary capacity of the central station and the distribution system, except when there is some means for storing electrical energy; many plants have no such means and therefore are comparable in that respect with a telephone plant. The period of peak load in a telephone plant is commonly termed the "busy hour." The load during this period fixes the maximum capacity of various portions of the plant. For example, it determines the number of operators' positions at the switchboard and in part determines the size and cost of the board. Again it determines the number of inter-office trunks required in a multi-office system and in turn fixes the cost of a considerable part of the distribution system. Other parts of the system, including land, buildings and various equipments in a central-office equipment might be mentioned.

The maximum demand per unit of connected load, or, in the case of telephone service, per subscriber's line, is well known to be much greater under flat rates than under meter or measured rates. The reason for this is well understood and lies in the fact that meter rates tend to suppress waste and unnecessary use. At the same time individual demands are diversified to a much larger degree by meter rates, and the collective maximum demand bears a lower ratio to the sum of the individual maxima. Any system of charging which gives rise to these tendencies will reduce the cost of service as a whole.

More specific illustrations are given in what follows. A subscriber who makes ten calls per day, for example, one per hour from 8 a. m. to 6 p. m., puts much less burden on the plant and on the operating force than a subscriber who makes ten calls in quick succession. Again, two or more subscribers who make calls simultaneously produce a greater burden than they would if their calls succeeded each other by some interval; and any subscriber who makes calls during the busy hour is a greater burden than one who makes his calls at other times. The ideal condition is a uniform load or demand, and

whatever tends in that direction obviously lowers the cost of service. The load-factor is a measure of the gross fluctuation in load and a high factor is just as desirable in telephone service as in central-station service. The factor ordinarily obtained in telephone systems is approximately the same, as a matter of fact, as that found frequently in central stations. A factor of forty per cent corresponds roughly to ten per cent of a whole day's traffic in the busy hour, and factors in that neighborhood are not uncommon. The means for improving load-factors in telephone service are not so obvious as they are, for example, in a lighting system, where day motor loads prove so beneficial. But the subject has received comparatively little attention, so that what can be accomplished along such lines is almost unknown.

Summing up the rate situation, we find both flat and measured rates in extensive use, but the latter confined in large part to the cities. Flat rates are still advocated and defended in many instances, and the consensus of opinion has reached no settled policy. The merits of the question are seemingly yet to be decided. Proceeding on the cost-of-service theory to study the problem, there is no way to attack it except through an elaborate analysis of all the costs of operation. This task involves too much detail for presentation here, but in its general aspects the matter will be discussed.

The best thought which has been given to the question of public-utility rates recognizes three primary elements in the gross cost. These are generally termed the consumer costs, the demand costs and the output costs. The first two are independent of the output or amount of service rendered; the third is proportional directly to the output or consumption. The first two, then, are constant, while the third varies. The latter grouping is often termed the principle of fixed and variable expenses, which has had extensive application in rate making, but not notably in telephone service. These elements of cost are duly recognized in both the readiness-to-serve and the maximum-demand systems, although not treated alike. The consumer costs comprise all charges which are individual to each consumer, or proportional directly to the number of consumers. They include, for example, the interest, taxes, depreciation and maintenance on a consumer's meter and the house portion of his drop, the cost of energy losses in the meter, the cost of meter reading, the cost of billing and the cost of collections. The demand costs comprise all the charges on the plant, which is used in common by all the consumers and whose size or capacity is fixed by the maximum demand. Among these can be enumerated the interest, taxes, insurance, depreciation and maintenance on the central station and the distribution system and the major share of the general expenses. The output costs embrace every item of expense which rises and falls in direct ratio with the output sales or service rendered. These are made up very largely of fuel, labor and miscellaneous expense for generating or manufacturing the output.

A very good idea of the relationship between these three elements of cost may be obtained from the skeleton analysis below:

			Class
Total Operating Cost	Fixed Part	Individual,	I
		Common,	II
	Variable Part,		III

Referring to this analysis, the three classes of cost there shown correspond, in respective order, to consumer costs, demand costs and output costs. This analysis is fairly familiar to those engaged in the central-station industry, but no proposition has yet been advanced, within the writer's knowledge, to apply it to telephone service. Still there is no obvious reason why it should not be applied, and it remains to test it by actual trial.

The operating costs as a whole are divisible, from an accounting standpoint, into operating, maintenance, general, taxes, insurance, depreciation and interest; this of course is a general classification to fit average conditions and is not necessarily complete as regards special items. The first three items fall broadly under the heading of operation, while the remaining four are overhead or plant charges. Taking up first the overhead charges, it is necessary to analyze the plant cost and separate it into two parts corresponding to classes I and II in the above analysis. Having done this and computed or distributed the overhead charges, the next step is the separation of operation charges into all three classes. These operations are naturally separate in working out an actual case, but in what follows no effort has been made to observe the usual order.

Commencing at the subscriber's end of the plant, his equipment is naturally the first consideration; this of course is individual and falls in class I. The same is true of his line to the central office and also of the following parts of the line in the office itself: a pro rata of the main and intermediate distributing frames, the line and cut-off relays and a pro rata of the mounting of the same, the answering jack and line signal and the office cable up to the jack, a pro rata of the switchboard framework and also a pro rata of central-office land and buildings. The pro-rata basis in each case will not be the same; it may be on a basis of the number of lines, or the floor space, or the investment, as seems to be most equitable. The interest, depreciation, taxes, insurance and maintenance on this portion of the plant are almost completely independent of the use made of it and fall in class I. A possible exception occurs in the case of cords on subscribers' telephones and again in the matter of lamp renewals in the line signal at the switchboard; so far as the maintenance of such equipment is proportional to use it falls in class III. The balance of class I costs includes directory expense, meter reading, billing and collecting, and a pro rata of the following items: central-office light, heat, etc., operation and maintenance of utility equipment, uncollectable accounts, superintendence and clerical expense in the maintenance department, plant testing and plant inspection. The distribution of the items last enumerated might follow labor, or materials, or the sum of both, or again some different basis, according to circumstances.

The distribution system will embrace five classes of lines, as follows: subscriber, private, leased, local trunk and toll lines. The entire interest, depreciation, taxes, insurance and maintenance, including a pro rata of general maintenance items, is distributable on a basis of wire mileage. Subscribers' lines fall in class I, and likewise private or leased lines, but in a separate sub-class. The distribution system commences at the junction of the office cables and the underground cables and extends as far as the protector at the entrance to a subscriber's premises, or to the entrance itself; drop wires belong to the distribution system, but a protector is part of a subscriber's

equipment. The charges on local trunk lines fall into class II entirely; the charges on toll lines fall into a special class and are wholly excluded from the present consideration.

Those parts of central-office equipment not already listed in class I belong in class II, including the multiple, the keyboards and cords, the cord-circuit equipment, the trunk equipment, the power plant and the remaining pro rata of land, buildings, switchboard framework, main and intermediate frames, coil and relay racks and office cables; also the information and supervisory desks, manager's desk and wire chief's desk. The interest, depreciation, taxes and insurance on this part of the plant fall in class II; the maintenance is separable into classes II and III. The class III maintenance, which is substantially proportional to use or traffic, covers jacks, plugs, cords, plug shelves, keys, keyboards and signal lamps.

The traffic expense, which comprises superintendence, clerical and operating labor, supervision and service inspection, is directly proportional, for the greater part, to the daily traffic. Probably ninety per cent of this expense falls in class III. The expenses of the latter class also embrace, besides the maintenance items already mentioned, the cost of central-office power and those items of general expense which cover the making up and handling of operators' pay rolls and auditing the same.

This completes a brief outline of the method of cost analysis as proposed for telephone systems and as hitherto applied in its general principles to other public utilities. The analysis is not quite complete, however, because the entire traffic which originates or terminates in any exchange system is usually divisible into three parts, comprising local-exchange service, private and leased-line service and toll service. The private and leased-line costs fall into a special class by themselves; the plant charges on toll trunks and equipment and the operation charges for handling toll calls comprise still another class and should be compensated out of toll commissions or credits from toll revenues. All the remaining costs come under the class of local-exchange service, which is our principal consideration.

At this point it becomes necessary to find the proper units of service and of plant for distributing the gross costs in each of the three classes. The units for class I costs are easily found. Subscribers' equipment is easily classified according to character; and annual rentals for each class of station, or equipment combination, can be worked out with no particular difficulty. Those costs which are proportional to the number of subscribers are distributable in an obvious manner. The charges for a subscriber's line are made up of two parts, one corresponding to the pro rata (on a mileage basis) of the distribution charges and the other comprising the charges on the central-office part of the line as before described; the first part is found by taking the product of the average annual charge per mile of wire (in service) and the average length of a subscriber's line in wire-miles.

Since class II costs require the most consideration, those of class III will be disposed of first. The traffic unit is a local message, over any distance within the exchange zone and not usually exceeding a five-minute period. The whole cost in class III is divisible by the annual number of local messages, and the quotient is the unit cost per message. The manner of combining this unit in the service rate will be considered subsequently. The charge for a local message is assumed to be assessed wholly on the subscriber who originates it; other proposals in this regard have been advanced, but a full consideration of the business ethics here involved seems to exclude any plan except the one adopted.

The class II costs are proportional in a large measure to the size or capacity of the plant which is used by all subscribers in common; and hence, in turn, they are similarly proportional to the maximum demand. Granting that this is established, there are two well known methods of distributing these costs among the subscribers. The first is the readiness-to-serve principle, which is too well known to require discussion. It is a correct economic principle in rate making and much used, but it does not adapt itself to the needs of small users in such a way as to make an attractive rate, as a rule; and in consequence it is often discarded in favor of the maximum-demand system for customers of that class. The latter system is the one which has been chosen in this particular instance, as regards the class II costs.

(To be continued.)

New York's Submarine Telephone Cables.

There are now sixty-three armored submarine telephone cables leading from Manhattan Island, with a total number of pairs of conductors of 10,684. In addition, there are three cables laid in the subways of the Pennsylvania Railroad and five cables in a telephone subway across the Harlem River, which total 2,877 pairs. This makes seventy-one cables and 13,561 pairs of conductors passing under the North, East and Harlem Rivers.

Long-Distance Telephone Service in the Southwest.

The Consolidated Telephone & Telegraph Company has completed its line between Benson and Tucson, establishing a through connection from New York to San Francisco, by way of Los Angeles and Arizona. New long-distance conversational records have been established in the west by connections between Tucson and Denver, 1,108 miles, and from San Francisco to El Paso, 1,296 miles.

Bryan Suggests Wireless Legislation.

The recent accident of the steamer *Prinz Joachim* and the difficulty of getting into wireless communication with any other ship at the time has caused suggestions to be made that each vessel equipped with wireless shall be made to carry two operators. One or the other might then be on duty at all times to receive messages. This legislation is suggested by William J. Bryan who was on board the *Prinz Joachim* at the time of the accident.

More Loaded Submarine Telephone Cables for England.

In view of the success of the long-distance telephone service, with the Anglo-French and Anglo-Belgian loaded submarine cables, it is expected that more and longer cables of this nature will be laid in the near future to connect the British Isles with other countries on the Continent.

Production of Coal in Ohio.

Ohio has produced more coal than any other state except Pennsylvania, Illinois and West Virginia. Since coal mining began in Ohio, in 1838, according to the United States Geological Survey, the state has produced 581,189,306 short tons, the figures showing an almost steady increase.

Industrial Power

ELECTRIFICATION OF RAILWAYS.[1]

BY E. O'BRIEN.

The problem which confronts railway companies, and which is never capable of complete solution, is the provision of an economical, efficient and financially sound system of transport, which at the same time will be convenient for and popular with the traveling public. The business of the railway companies is to sell transport of both goods and passengers, and it matters little to the buyers what method of traction is employed to convey them or their goods, from one point to another, so long as it is done in a safe and expeditious manner.

Rapidity of transit is an all-important consideration, and in the selection of a system this point must be kept well to the front. Of the traveling public, the most important section is formed of business men, and with them especially time is money. With the growth of manufacturing centers, and as a result, the driving further afield of desirable residential localities, more and more time per day must be given to traveling, and since it is impossible to provide every passenger with his express train, the system of traction which will give a high schedule speed where stops are frequent, is the one which will succeed. The distance that the business man can live from his business is therefore not to be reckoned in miles but in time, and the limit of this may be placed at one hour.

The conditions required for such a successful passenger service are fulfilled by electric traction. High acceleration and consequent high schedule speed can be obtained, increasing the radius of the residential area, and giving a service which is convenient to all those who dwell in this area. In any district where two different systems of transit are in use, the more rapid system will inevitably rob the slower system, suburban districts will be developed, and an increased density of traffic result. The cost of any system of transit increases very rapidly with small increases of schedule speed, so that the increased density of traffic has to be relied upon to make the more rapid transit a profitable undertaking. It follows, therefore, that it can only succeed in localities where passengers can be gathered in from slower systems of transit, or where there are districts to develop for residential or other purposes. This development incidentally brings with it not only an increase in passenger traffic, but also in freight.

As the maximum economical schedule speed with stations about 1.25 miles apart is nearly 30 miles per hour, on the assumption mentioned that one hour represents the maximum distance the business man will live from his work, the radius of economical and remunerative suburban traffic may be placed at approximately 30 miles from any large town. Of course it will be understood that it would not be worth while to electrify many suburban lines for such a distance as this, owing to the intermediate stations being unsuitable for residential purposes, and also the business carried on at these stations not necessitating frequent connections with the urban center.

We may now proceed to consider the technical reasons for the economy of electric traction applied to suburban traffic, and the probability of its success in other fields such as main-line express work and for freight trains.

Steam traction, for rapid suburban traffic, has reached its limit; any attempt to run an electric schedule with steam trains increases the cost, both of fuel and maintenance to a prohibitive point. For ease and flexibility it compares very unfavorably with electric traction, in fact many things can be done with the latter which are impossible with steam. An electric motor car will run 50,000 miles without visit-

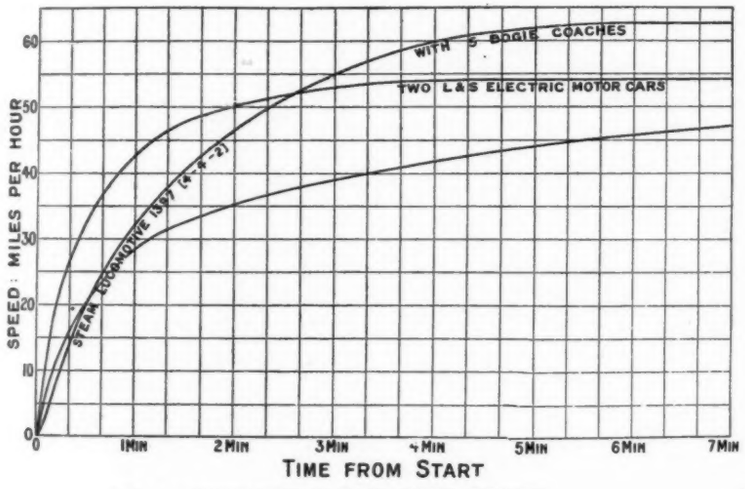


FIG. 1.—COMPARATIVE TIME-SPEED CURVES.

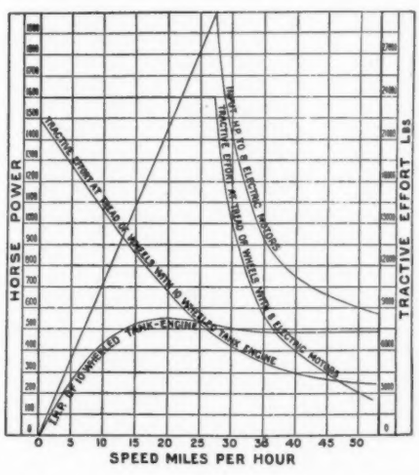


FIG. 2.—COMPARATIVE TRACTIVE-EFFORT CURVES.

[1] Abstract of paper read before the recent meeting of the Manchester Association of Engineers.

ing the shed other than for stabling, and can be kept in continuous service for twenty hours daily, the only attention required being brake adjustment. A steam locomotive on a similar service must obtain coal every 150 miles, and requires a thorough washing out and overhaul every 1,200 miles at the least. By reason of its higher acceleration and average speed on short runs, the electric service can be increased in frequency with the same headway between trains, thus increasing the capacity of the line. This increase of capacity shows to the greatest advantage at terminal stations, where it is almost 100 per cent.

Instead of stand-by engines, and a dozen switching and signalling operations being required, during which two or more roads are blocked, and which cannot be completed under five minutes even with the most favorable conditions, the electric train is ready to depart as soon as the motorman can walk from one end to the other. As an instance of the dispatch which is possible may be cited the Aintree Race Traffic on the electrified portion of the Lancashire & Yorkshire Railway where an electric train discharges a thousand passengers, the time between arrival and departure being ninety seconds.

Fig. 1 gives the time-speed curves of a multiple-unit two-car electric train, a ten-wheeled express passenger engine with five coaches, and a ten-wheeled radial-tank engine used for suburban traffic with seven coaches.

Though the test of the electric train was carried out with two cars only, the same acceleration can be obtained with any number of cars since each carries its own motors. Table I gives the particulars.

The reason for the higher acceleration is at once apparent from the curves in Fig. 2, in which a steam and electric train of similar maximum tractive effort are compared. The tractive effort which can be applied to a train is limited by the slipping of the wheels,

TABLE I.

	Steam Train. Express Passenger.	Suburban Passenger.	Electric Train.
Total weight (taken the same in each case).....	205 tons	209 tons	205 tons
Number of Vehicles	5	7	4
Total seating capacity	300	400	306
Weight required for propulsion..	90 tons	77.5 tons	71.1 tons
Acc. up to 10 M. P. H. in M. P. H. per sec.	0.67	0.95	2.0
Acc. up to 20 M. P. H. in M. P. H. per sec.	0.67	0.67	1.65
Acc. up to 30 M. P. H. in M. P. H. per sec.	0.57	0.43	1.2
Maximum speed..	65 M.P.H.	60 M.P.H.	54 M.P.H.

and an electric train with eight driving axles has a very considerable advantage over a steam train with only two. The maximum effort can be maintained up to twenty-seven miles per hour with the electric drive, whereas the tractive effort with steam falls rapidly, and at twenty-seven miles per hour is only one-third of the maximum.

The advantage of the higher acceleration gradually decreases with the length of the run, and in the case where the maximum speed of the steam train is greater than that of the electric it disappears altogether, i. e., the average speed is the same when the distance traversed is five miles.

Due to the ease with which high acceleration can be obtained, electric traction lends itself to the most economical running. High acceleration means high average speed approaching the maximum speed. Thus the train obtains its maximum speed very quickly, and the power may be shut off, and advantage taken of the good coasting qualities of electric stock, to run the greater part of the journey absorbing the energy stored in the train. For the same schedule, the lower the acceleration the longer the power must be kept on, which in turn lessens the time for coasting, the energy put into the train being almost wholly absorbed by the brakes. The effect of this is shown in Figs. 3 and 4, in which the curves A, B, and C in each diagram indicate the time-speed curves and power required for three different accelerations, particulars of which are given in Table II.

TABLE II.

Curve.	A	B	C
Mean acceleration up to 25 miles per hour in M. P. H. per sec...	0.58	0.86	1.47
K. W. Hrs. for one-mile run at schedule speed of 25 M. P. H...	9.0	7.45	7.1
Watt-hours per ton-mile.....	63	52	49

The length of run and time taken is the same in each case, and the train consists of four cars, total weight 144 tons.

Fig. 5 shows the decrease in energy consumption with increase of acceleration up to 2.3 feet per second.

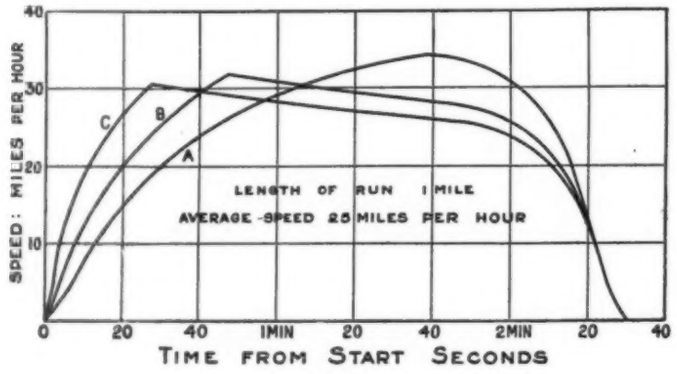


FIG. 3.

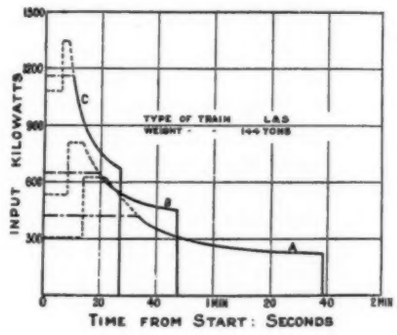


FIG. 4.

It will be noticed that the speed during coasting decreases very slightly, and that the train is still traveling at a high speed when the brakes are applied. A considerable amount of energy is therefore absorbed by the brakes. Since all this energy must necessarily be imparted to the train during acceleration, and as the amount of energy is proportional to the weight of the train, it follows that this latter is a matter for serious consideration. The cars should be as light as possible, consistent with safety and comfort.

It will be noticed that for short runs the energy is almost exactly proportional to the weight of the train, but that this is not so for longer runs. This is due to the energy on the shorter runs being almost entirely used in accelerating the train, whereas on the longer runs the effect of the train resistance predominates. The shorter the runs, therefore, the more important it is to

keep the rolling stock as light as possible.

SYSTEMS OF ELECTRIC TRACTION.

The earlier systems of electric traction were, without exception, direct current. In recent years, however, alternating-current traction, especially single phase, has made rapid progress. The systems are classified in Table V.

TABLE V.

Systems of Electric Traction.

Direct Current	Alternating Current
(1) Generated and distributed at the line voltage.	(4) Single Phase
(2) Generated at high-voltage alternating current and transformed down and converted to low-tension direct current at Substation.	(5) Three Phase
(3) High-tension direct current.	

System (1) is in general use in the smaller light railway and tramway systems. The generators work at the line voltage, and are connected directly to the line by feeders. For outlying districts boosters are used to maintain the line voltage.

System (2) is in general use in the heavier railway systems. It combines the high efficiency and economy of generating and distributing at high-voltage alternating, in nearly every case three-phase, and the simplicity of direct-current traction. Substations are fixed as required along the line, and conversions made from high-voltage alternating to low-voltage direct by means of transformers and rotary converters or motor generators. Progress has been made recently in system (3)—high-tension direct current. The objection to this system, or, rather, the obstacle to progress hitherto has been commutator trouble with increase of voltage. This is being gradually overcome, and a system evolved which will combine the simplicity and economy of direct-current motors with the economy of high-tension transmission, which has previously been monopolized by alternating-current systems, and this will be done without any intermediate conversion.

In systems (4) and (5), alternating-current single-phase and multi-phase motors are used. Current is transmitted either direct to the cars at high voltage where it is transformed down, in the case of single phase to a low voltage for the motors, or in the phase of three-phase current high-voltage motors are used. In long-distance transmission schemes the generators work at extra high voltage, and static transformer substations are used to transform the power to line voltage.

The direct current being continuously in one direction may be compared to a steam turbine, the alternating single-phase finds an analogy in a single-cylinder reciprocating engine, and the three-phase in the three-cylinder engine.

Heavy electric traction is by no means an electrical engineering problem pure and simple. A special knowledge of the conditions which obtain on railways, and which can only be acquired by actual experience in the traffic and locomotive departments, is essential for the solution of the problems involved. A lack of this knowledge on the part of electrical engineers has rendered progress in electrical traction slower than it would have been otherwise. It is not only the railway engineering side of the question which is neglected but also the financial side. This is detrimental to progress, for the railway official looks upon electric traction from a railway point of view, that is, the scheme must be firstly financially sound, then it must conform as closely as possible to railway conditions, and lastly comes the electrical engineering part of the problem. The choice of a system then is one which must be considered on the lines just indicated.

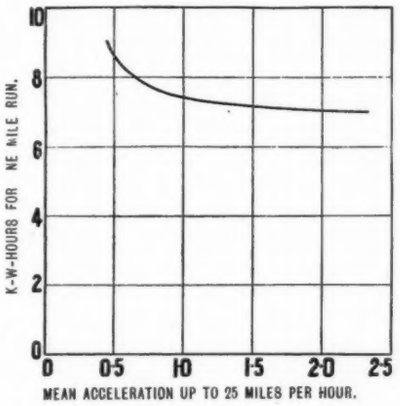


FIG. 5.

It must be remembered that in the electrification of a steam railway the line already exists, with its junctions, cuttings, bridges, sidings, and signals.

With the three-phase system two overhead wires at least are required, the third conductor consisting of the track rail. This leads to such complications at junctions and crossings that it has been generally realized that except for lengths of line, which have very few junctions and crossings, this system is not suitable. It necessitates an overhead system, which in turn means high voltage if the weight of conductor is to be kept within reasonable limits, and it is not generally realized by the exponents of the overhead system that it is often very difficult and sometimes impossible, without structural alterations to bridges and signals, to design it to overcome all the difficulties in the way. This is especially the case in this country.

On the continent some of the lines which run across flat, open country, with few bridges, seem physically adapted for overhead construction, but these are exceptions, and the difficulties which are in the way can be best realized by actual inspection.

Chief among the difficulties is the location of the supports for the overhead network; the usual allowance of six feet between the tracks does not admit of poles being erected in this open space, still less of a support of the lattice-girder type.

In some cases the construction of the lines is modified so as to allow of a wider space than six feet between the lines, but in nearly every case this is occupied by signals, telegraph and telephone poles, and other necessary railway equipment which cannot well be removed, or if the supports are fixed they may be in the way of further widenings and extensions. Overhead construction necessitates special work at all sidings to make room for the supports, and also for moving signal wires and posts, etc.

In some cases where room cannot be found for supports excessively long spans would be required, especially at the entrance to large stations. On the other hand, the laying of a third-rail involves no special work of any kind except an occasional simple bend in the rail and a little cable laying.

The obstacles encountered are easily and cheaply removable, and the most serious costs involved are in slight alterations to runs of signal and point roddings.

The actual erection of the overhead line also presents difficulties, and in converting a busy railway to electric traction a greater part of it would have to be done at night or on Sundays to avoid interfering with traffic. This, of course, would add greatly to the cost incurred by the special work required.

It is not generally realized by those not intimately connected with railways that a large proportion of main-line

railway mileage lies in the neighborhood of large towns, and, as a natural corollary to this, neither is the unremunerative expenditure realized which would have to be incurred in providing electrical equipment on the overhead system for long lengths of sidings and running loops which, though very necessary, are only in active use for a small proportion of the day; for instance, more than one-third of the total track mileage of the L. & Y. Railway consists of sidings, exclusive of loops; for it is to be presumed that any general electrification of a railway would include the operation of freight trains, as otherwise not only would a remunerative night load on the power house be lost, but extra cost would be incurred in maintaining both locomotive and electrical establishments.

For main-line work the systems are on a fairly equal footing, but when the work in the vicinity of, and in towns, and the sidings and loop work is considered, the cost per mile will be less for the third-rail system, but will be much greater for the overhead system on account of the physical difficulties already mentioned. It may be noted that in the case of heavy third and fourth-rail construction, say using an eighty-pound rail, the cost of the working-conductor material is about sixty per cent of the cost of track electrification, but in the case of high-tension overhead construction it is only fifteen per cent; the third-rail construction therefore lends itself to economy in first cost in dealing with sidings and loops, referred to above, as the cost per mile can be readily reduced by using a lighter conductor where traffic is light and high momentary electrical losses are permissible.

To sum up the conditions in the neighborhood of large towns where electric traction would be most profitable preclude the adoption of overhead construction, or the single or three-phase systems; it is therefore probable that the direct-current third-rail system will gradually be brought into use by the more progressive railway companies, where, as before stated, there is either a residential neighborhood to develop or a slower means of transit to be competed with. The extent of such a system of suburban electric transit may become so large as to make it profitable to work the local freight service from the same power house as the passenger trains; further than this two large towns fairly adjacent, such as Glasgow and Edinburgh, Newcastle and Darlington, Liverpool and Manchester may each have such a suburban freight and passenger electric system, and this may lead to the electrification of the main line between two such cities, and this in its turn to the electrification of an entire system. Probably a power station will feed about 25 to 30 miles as a maximum distance—i. e., there will be about 60 miles between generating points; but cheap coal, water and land will be principal deciding factors. Whether single-phase or direct-current third-rail is used, batteries will be installed to a large capacity, probably sufficient to run any section of the line for an hour on a reduced schedule, thus acting both as load equalizers as well as a stand by.

Thus the electrified railway of the future appears to be a continuous-current third-rail system for suburban and interurban lines with possible stretches of straight-forward main line, on the single-phase system. This, of course, precludes the movement of the suburban motor-coaches or shunt engine from one district to another; but this movement does not take place in practice, and this is no practical objection. Freight yards will only have their entrances electrified and will be worked largely by storage-battery locomotives. Only by this means can the prohibitive cost of overhead construction or the unnecessary use of the third-rail and the comparatively useless electrification of sidings only used occasionally by a locomotive be avoided.

Electricity in Mines in Scotland.

In a pamphlet circulated at the annual meeting of the Association of Mining Electrical Engineers at Glasgow, giving some general notes on the Scottish coal fields, it is remarked that the first electrical installation at a colliery in the world, was put down at Earnock Colliery in the Hamilton district in the year 1879, says *Electrical Engineering*. The late Lord Kelvin advised the erection of a dynamo to light the pit bottom of this colliery. A Gramme machine capable of lighting thirty lamps was supplied by Anderson & Munro and was installed as an experiment under the direction of Professor Jamieson. It proved so successful that shortly afterwards three Siemens dynamos capable of lighting sixty lamps each were introduced to light the pit-head arrangements, and extending the pit-bottom lighting to the stables and main roads.

Practically every mine in Scotland has now adopted electrical power very extensively for lighting, pumping, hauling, coal cutting, face conveying, and ventilation, and in a few cases for hoisting. The generating plants represent the latest developments in high-speed engines, high pressure, mixed pressure, and exhaust turbines, and all their latest adjuncts in the form of air filters, condensing and water-cooling apparatus. The principal stations vary in capacity from 500 to 2,000 kilowatts and fairly well represent the leading makers of turbo-generating equipment. Till a few years ago the installations were entirely of the direct-current type, but in recent years, with the introduction of the central station for groups of collieries, high-tension three-phase transmission has become fairly common.

California Leads in Oil Production.

California heads the list of producers in 1910, with 73,010,560 barrels of oil, an increase of 17,538,959 barrels over the production in 1909. This output is more than twice as great as that of Pennsylvania for any year, and is greater than that of any foreign country. The average price per barrel of California oil in 1910 was 49 cents, the total value being $35,749,473.

The second among the oil-producing States in 1910 was Oklahoma, with a production of 52,028,718 barrels, valued at $19,922,660.

Subway Work Begins in the Bronx.

On December 4 subway work began in the Bronx, this being the first actual work of subway building carried on in that section of New York City. The part on which construction was commenced is section 15 of the Lexington subway, running from the north side of Harlem river to One Hundred and Fifty-Seventh Street.

Asbestos Manufacture.

In 1910 the United States excelled all other countries of the world in the conversion of raw asbestos into manufactured products, but a very small percentage—less than one per cent of the asbestos used—was mined in this country.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN LIGHT & TRACTION.

The report of the American Light & Traction Company for the month of October and ten months ended October 31, compares as follows:

	1911	1910
October gross	$ 367,641	$ 356,685
Expenses	10,757	11,126
October net	356,884	345,559
Ten months' gross	3,293,344	3,009,842
Expenses	94,626	100,550
Ten months' net	3,198,718	2,909,292

NORTHERN OHIO TRACTION & LIGHT.

The report of the Northern Ohio Traction & Light Company for the month of October and ten months ended October 31, 1911, compares as follows:

	1911	1910
October gross	$ 220,342	$ 208,342
Expenses	123,854	113,371
October net	96,488	94,971
Charges	44,321	43,367
October surplus	52,167	51,604
Ten months' gross	2,240,089	2,045,748
Expenses	1,234,358	1,123,229
Ten months' net	1,005,730	922,519
Charges	443,390	433,527
Ten months' surplus	562,340	488,991

SUSQUEHANNA RAILWAY REPORT.

The annual report of the Susquehanna Railway, Light & Power Company for the twelve months ended September 30, 1911, shows a surplus of $383,073. This is equal to five per cent of the $4,198,000 outstanding common and an additional two per cent on the combined common and preferred stocks, as, after the payment of five per cent dividends on the common stock, the preferred will share equally with the common in non-cumulative dividends up to seven per cent. The income account follows:

	1911	Increase
*Proportion	$509,930	$132,780
Interest on securities	53,514	†5,530
Miscellaneous other income	37,588	19,664
Total income	$601,033	$146,914
Preferred dividend	217,960	13,350
Balance	$383,073	$133,564

*Proportion of surplus earnings of subsidiary properties represented by their stock controlled by the Susquehanna Railway, Light & Power Company, after deduction of all charges. †Decrease.

TWIN CITY RAPID TRANSIT COMPANY.

The report of the Twin City Rapid Transit Company for the month of October and ten months ended October 31, 1911, compares as follows:

	1911	1910
October gross	$ 655,591	$ 645,358
Expenses	313,915	308,743
October net	341,676	336,615
Charges, taxes, pfd. div., etc.	140,079	140,321
October surplus	201,597	196,295
Ten months' gross	6,508,029	6,265,727
Expenses	3,212,702	2,996,849
Ten months' net	3,295,327	3,268,877
Charges, taxes, pfd. div., etc.	1,400,792	1,401,973
Ten months' surplus	1,894,535	1,866,904

MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company for the month of October compares as follows:

	1911	1910
October gross	$ 442,393	$ 386,688
Expenses	232,202	205,750
October net	210,191	180,938
Charges and taxes	35,697	31,998
October surplus	174,494	148,939

MASSACHUSETTS ELECTRIC COMPANIES.

The Massachusetts Electric Companies has issued its report for the year ended September 30, 1911. The consolidated income account of operating company compares as follows:

	1911.	*1910.
Gross earnings	$8,881,520	$8,560,949
Expenses	5,557,303	5,360,294
Net earnings	3,324,217	3,200,654
Charges	1,838,579	1,792,936
Balance	1,485,637	1,407,717
Dividends	1,169,090	1,130,561
Surplus	316,547	277,156

*Year ended June 30.

INTERBOROUGH RAPID TRANSIT.

The earnings of the Interborough Rapid Transit Company for the month of October compare as follows:

	1911.	1910.
Gross operating revenue	$ 2,707,569	$ 2,547,654
Operating expenses	1,079,598	981,748
Net operating revenue	1,627,972	1,565,906
Taxes	149,980	154,694
Income from operating	1,477,992	1,411,213
Other income	37,067	29,550
Total income	1,515,059	1,440,763
Interest, rent, etc., including March guar.	919,113	904,812
Net corporate income	595,946	535,951
Passengers carried	52,717,754	49,543,316

The earnings of the Interborough Rapid Transit Company for the four months ended October 31, 1911, compare as follows:

	1911.	1910.
Gross operating revenue	$9,314,938	$8,968,020
Operating expenses	4,154,214	3,727,518
Net operating revenue	5,160,724	5,240,501
Taxes	655,021	611,871
Income from operating	4,505,702	4,628,630
Other income	122,857	117,804
Total income	4,628,559	4,746,434
Interest, rent, etc., including Manh. guar.	3,623,937	3,557,970
Net corporate income	1,004,622	1,188,464
Passengers carried	180,743,699	173,790,798

*The increase in operating expenses is largely due to extraordinary expenditures, the result of changes in subway equipment made necessary in connection with the operation of ten-car express and six-car local trains.

Dividends for three months ended September 30, 1911, amounted to $875,000; for 1910, $787,500.

Electric Portable Lamps in Mines.

At the recent annual dinner of the Scottish branch of the National Association of Colliery Managers, held in Edingburgh, William Walker, chief inspector of mines for Scotland, referred to the question of the early introduction of electric portable lamps into mines. During the past year alone, he said, they had had in Scotland no fewer than twelve fatalities caused by the ignition of gas, eleven of which occurred in naked-light pits. During the same period ninety-four burning accidents had occurred, and in every instance it was an open-light pit which was affected. In the present controversy as between safety and open lamps, the claims of the electric portable lamp—a most practical proposition—were being entirely overlooked. He knew of one mine where 2,000 of these electric lamps were in daily use, and he looked forward not only to an improvement in these lamps, but to a more general use of them in the near future.

Examination for Rural Engineering Specialist.

The United States Civil Service Commission announces that on January 3 an examination will be held at the regular places to fill a vacancy in the position of specialist in rural engineering, Office of Experiment Stations, Department of Agriculture, at Washington, D. C., at a salary of from $1,500 to $1,800 per annum.

The duties of this position will consist in the preparation of reviews and abstracts of English and foreign scientific works and journals for publication in the *Experiment Station Record*, a monthly publication devoted to the review of agricultural literature and other publications having a direct bearing upon agricultural science and practice. The person appointed to this position will be assigned to the reviewing and abstracting of articles on rural engineering subjects. Applicants should therefore have had special training in these subjects and also possess a reading knowledge of French and German.

A New Dry Storage Battery.

A patent has been issued in England on a dry storage battery. The construction of the battery is briefly described as follows: The positive electrode is a carbon block of star-shaped cross section, fitted into the center of a block of depolarizing material. The electrode is separated from a zinc electrode of square section by a series of cane strips one-eighth inch square to allow for air circulation. In charging the cell contact is made with the zinc through the moisture absorbed by the cane strips from the electrolyte. As the charging proceeds a spongy deposit collects on the zinc and makes a permanent porous connection between the zinc and the electrolyte.

Chinese Railway Electrifies.

The Paknam Railway Company has entered into an arrangement with the Siam Electricity Company to electrify the line between Bangkok and Klong Toi.

New Electrical and Mechanical Apparatus and Appliances

The Iron-Loss Voltmeter.

The standardization rules of the American Institute of Electrical Engineers provide that in determining the ratings of alternating-current machines or apparatus, a sine wave of alternating current and voltage is assumed. This suggestion has been adopted by practically all manufacturers as a basis for temperature and performance guarantees. The reason is obvious. The wave shape affects the iron loss and, therefore, the general performance of most apparatus. Practically every generator, except those designed particularly to give a true sine wave of voltage, will produce a wave shape different from that produced by other generators, and even with those designed to produce sine-wave voltage at their terminals, the circuit will likely distort the wave so as to cause it to vary considerably from the true sine.

As it is impossible to make guarantees that will apply to all wave shapes, and as there is no simple way of designating any wave shape other than a sine wave, the sine wave of voltage has been adopted as a standard in order that results may be compared intelligently.

Difficulties arise in attempting to correct test results for the deviation of the wave used from the true sine shape. Special apparatus is required to determine the actual shape of the wave. After the wave shape is determined, the form-factor must be found, a complicated calculation. Hysteresis loss is affected by the wave shape, while eddy-current loss is not, which makes it necessary to separate these losses before the form-factor correction can be applied.

Another factor affecting results to a large extent is the frequency of the testing circuit, and the correction for it is difficult. It is almost impossible, particularly where tests are made at a substation, to bring the frequency to normal, and consequently a large error in actual and comparative results may be introduced.

To get around these difficulties and provide a simple method of making transformer tests which are correct for normal frequency and sine-wave voltage, the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has placed on the market the iron-loss voltmeter, an instrument that is invaluable to a central station or laboratory requiring tests on transformers in terms of sine voltage and normal frequency. The purpose of the instrument is to make possible the adjustment of the voltage of a circuit with any shape of

IRON-LOSS VOLTMETER.

voltage wave, and any frequeney above or below normal, to such a value that the effect is the same as that of normal voltage of sine-wave shape and normal frequency. By the use of this voltmeter and any convenient means for varying the voltage of the testing circuit, practically any wave shape of voltage or frequency error can be compensated for in the test. This is accomplished by setting the index pointer of the iron-loss voltmeter for the normal voltage at which test results are desired, and then adjusting the voltage by means of a rheostat or other device until the moving-coil pointer is on the mark.

It will be apparent that this method does not produce a sine-wave voltage of normal value, nor does it change the wave of the applied voltage, but it compensates so that the effect on the iron loss is the same as the normal sine wave would produce.

This method of testing is extremely accurate. The American Institute rules permit a deviation of the wave from the sinusoidal shape of ten per cent, but this deviation is intended as a limit for the wave produced by apparatus guaranteed to produce a sine wave, and is not intended as a basis for tests. It has been shown that tests made on various wave shapes within the limits of the nominal sine wave vary as much as 7.8 per cent above and 5.8 per cent below what would be obtained with actual sine-wave voltage. It is evident, therefore, that tests made on any wave shape should be corrected to sine-wave values. In making such correction by means of oscillograms, it has been found that tests obtained on different wave shapes give results which vary as much as 2.5 per cent. With the iron-loss voltmeter a large number of tests of different transformers on a variety of commercial wave shapes show that the result obtained varies not more than one per cent from the result obtained on sine wave and normal frequency. The time required for the test is also reduced to a few minutes.

The instrument consists of a laminated core of silicon-steel and a wattmeter which measures the total iron and copper loss in this core and the instrument combined. The coil surrounding the steel core is connected in series with the load coils of the wattmeter. The shunt circuit of the wattmeter consists of a non-inductive resistance, the moving coils of the instrument and turns on the field coils of the same number as those in the series connection. Consequently the entire copper loss of the instrument is included in the reading of the wattmeter.

The volt scale of the instrument is calibrated by connection to a circuit giving a sine wave and a definite frequency. Under this condition the volt scale is made to agree with the readings of a standard voltmeter on the same circuit. A second scale is graduated in watts and is a great convenience, as it enables the instrument loss to be ob-

tained without any calculation. Before calibrating the instrument the proportion of eddy-current and shunt-copper loss to hysteresis is adjusted so as to correspond with that of the average transformer.

In addition to the possibility of making iron-loss tests on transformers and other inductive apparatus intended for connection in multiple with the circuit, the iron-loss voltmeter can be used to determine normal exciting current and for making a reliable heat run. The normal exciting current is determined by correcting the shape of the wave by any convenient means until the iron-loss voltmeter and an ordinary root-mean-square voltmeter indicate the same voltage. The voltage wave then has the same form-factor as a sine wave, and by suitable correction for frequency the normal exciting current is determined.

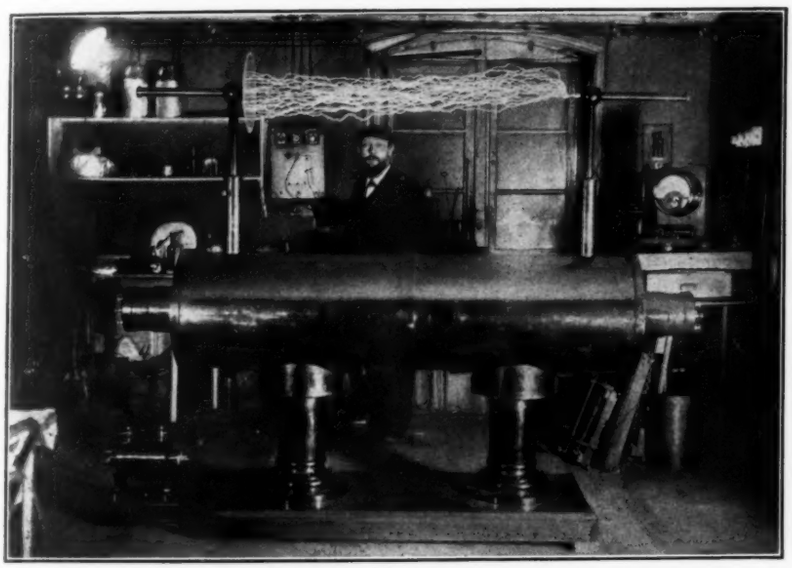
In making a heat run, the voltage is adjusted as in the iron-loss test, until the iron-loss voltmeter reads normal voltage, with full-load current in the apparatus. Under such conditions both the iron loss and the copper loss are normal, and the results of the test can be depended upon as representing the normal performance of the apparatus tested.

The advantages of this system of testing must appeal to every central-station man operating a plant of any size. It permits simple tests to check the claims of manufacturers and to compare competing apparatus before purchase.

A Million-Volt Spark Coil.

The accompanying illustration shows a remarkable high-tension spark coil producing a potential of one million volts with a spark measuring 125 centimeters in length. The photograph shows the designer, Professor Klingelfuss, of Basel, Switzerland, in the background, controlling the switch in his laboratory.

A coil of this design has been placed in service at the Astrophysical Observatary in Potsdam and a similar induction coil designed by Dr. Klingelfuss is utilized in Vienna, Austria, by Professor Reithoffer at the Technical School. It may be stated that for a spark length of 100 centimeters the potential is over 800,000 volts and, at the capacity of the coil, over 1,000,000 volts with a spark gap of 125 centimeters.



A MILLION-VOLT SPARK COIL.

Lamp Manufacturers Capture Baseball Title.

An official statement has recently been issued by C. C. Townes, president of the Industrial Baseball League of Cleveland, O., awarding to the "National Mazda" baseball team, composed of men in the engineering and other departments of the National Electric Lamp Association, the championship title for the playing season of 1911. The other contestants for the title were the Sherwin-Williams Company, Standard Sewing Machine Company, Lockwood-Luetkemeyer-Henry Company, William Bingham Company, American Can Company and Cleveland Twist Drill Company.

Electrically Operated Road Roller.

An electrically operated road roller is used by George Stump, a contractor of Independence, Kan., according to the *Engineering News*. It has a rear roll 4 feet in diameter and 4.5 feet wide and a front roll 3 feet in diameter by which the steering is done in the usual way. The whole machine weighs 7.5 tons. A 10-horsepower, 220-volt, single-phase motor is mounted with its shaft running back like the shaft of an automobile to a transverse shaft, from the ends of which the rear roll is driven by chains. During ordinary operations the motor runs all the time and the movement back and forth of the roller is controlled by clutches. The roller is supplied with current through 160 feet of flexible cable from a portable step-down transformer mounted on cart-wheels. The primary side of this transformer can be tapped on to any 2300-volt, single-phase distribution circuit in the neighborhood of the street to be rolled, and the flexible cable is long enough for rolling any local 300-foot block. When the roller is to be used at a short distance from the existing transmission lines the central-station company puts up the necessary poles quickly at cost for the contractor. The transformer cart carries a watt-hour meter and current is supplied at ten cents per kilowatt-hour. Even at this high rate Mr. Stump finds the operating charges to be less than those of an equivalent steam roller, the cost of operating this roller in connection with the laying of brick pavements being figured at $6 per block.

An Electrical Warning Device for Motormen.

Alexander Shane, general manager of the Indianapolis, Columbus & Southern Traction Company, of Columbus, Ind., has perfected a novel signal to warn motormen constantly when they have a special order for meeting cars, etc.

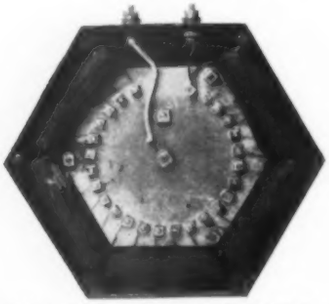
When such an order is taken the motorman opens a box to write it down. By opening the box he displays a red flag and a red light. The flag and light are constantly before him until the order has been obeyed. When the order has been carried out the motorman closes the box and the flag and light disappear.

It is said that with this arrangement it is almost impossible for a motorman to forget an order.

Unit-Coil Field Regulator.

A field rheostat placed on the market by the Independent Electric Manufacturing Company, Milwaukee, Wis., incorporates the idea of replaceable unit. Instead of winding a single coil in a cement body, in such a way that a break necessitates sending the entire rheostat back to the factory, the coils have been wound in a number of units each one of which is independent and may easily be taken out for replacement. The insertion of a new coil is only a matter of a few moments' work. Contacts are also easily removed.

These rheostats are made with five, seven, or nine units, as is desired by the purchaser. In all types the design has been carried out so that the piece of apparatus is of a pleasing appearance, has ample radiation and sufficient durability. The wire used is of a special composition which keeps a practically constant resistance at all working temperatures. The waterproof cement with which the coils are surrounded is made by the manufacturers of the rheostat. After making up the coils they are baked in the cement, making a very handy unit. The bottom of these and the unit coils may be seen in the accompanying illustration.



UNIT-COIL FIELD REGULATOR.

Two general types of the rheostat are placed on the market: one for mounting on the front of the switchboard, and one for mounting on the rear. In the former the handle furnished is of hard wood with a jet finish, while the handle supplied with the latter is of finished copper. A plate furnished indicates the direction the handle must be turned to raise the voltage.

Sizes which are now supplied in this shunt field resistance are for generators between one and 1,500 horsepower. In cases where the rheostat must carry over fifty amperes an open iron grid is used instead of the embedded coils, although the unit idea is the same as in the smaller sizes.

Electric Chafing Dishes and Frying Pans.

The rapidly increasing use of electrically heated apparatus for domestic purposes has led to the design of various devices and modifications of those already designed. Examples of these are shown herewith in the frying pan and the blazer-type chafing dish manufactured by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

BLAZER.

The frying pan is a very convenient cooking utensil particularly adapted for use in homes, restaurants, hotels, etc. It is not only a complete frying pan, capable of cooking everything that can be fried in the ordinary manner, but it can also be turned into an electric disk-stove by simply inverting it and is then suitable for all kinds of light cooking, toasting and similar uses.

It is made of sheet steel and has a polished metal handle. The heating element is located in the bottom of the pan and is hermetically sealed between steel walls so that it is completely protected from oxidation. The pan can be easily cleaned.

The pan heats very quickly and can be run at three different temperatures —high, medium and low. The desired temperature is obtained by means of an indicating push-button switch.

FRYING PAN AND STAND.

The stand is made of aluminum and is so designed that the frying pan can be run at full heat without injuring the surface of the table on which it is supported. The whole outfit is very light.

The Westinghouse blazer-type chafing dish is the most improved form of this popular utensil. In it there is absolutely none of the danger from fire and explosion which is always present when alcohol is used. The heat is uniformly distributed over the bottom of the pan, thus eliminating the overheated center and cold sides which are unavoidable when heat from a flame is used.

The dish can also be operated at three heats—high, medium, and low—and the temperature at each heat is always the same, so that results once obtained can always be duplicated. It is always ready for use and consumes so little current that it is more economical than the alcohol-heated dish.

This chafing dish is similar to the ordinary type except that it has three pans instead of two—a water pan, a food pan, and a blazer. The water pan and the food pan are the same as used with the ordinary alcohol chafing dish.

The blazer contains the heating element hermetically sealed in the bottom. It is similar to the food pan in appearance and can either be used as a food pan for operations requiring high temperature, as in frying, or it can be filled with water and used to heat the food pan, which fits within it, when mild heat is wanted.

BLAZER-TYPE CHAFING DISH.

An indicating plug switch controls the temperature. The high heat is ordinarily used to bring the chafing dish to the desired temperature. The low heat will keep water boiling after the boiling point is once reached and is useful for keeping food warm. The medium heat is the highest that is usually wanted for most cooking in the blazer.

All metal parts are handsomely finished in polished nickel or copper. The handles are ebonized wood. The blazer is designed to fit the most popular sizes of chafing dishes and contains all the parts necessary for electrical operation. By its use the most popular makes of alcohol chafing dishes may be operated by electricity with no changes of any kind.

The exports of coal from the United States during 1910 were 13,805,866 long tons, valued at $41,470,792. Of this quantity 3,021,627 long tons, valued at $14,785,387, was anthracite.

A New Form of Resonator.

A new form of resonator, consisting of a Tesla transformer with provision for tuning by the adjustment of the number of tunes in the primary coil, has recently been constructed for experimental purposes at the University of Detroit. The following description is due to John B. Kremer:

Fig. 1 represents a side view of the apparatus with a sectional view of the high-frequency primary *PP*. Fig. 2 shows a plan. The heavy circle on the spiral in Fig. 2 is a top view of the secondary *H* in Fig 1. As is evident from the figures, the primary, instead of being wound in the usual cylindrical form, has the shape of a flat spiral, lying on the table. The tuning of the primary circuit to the various secondary circuits —for several secondaries are in use—is done by taps brought out to the front of the table as shown in both figures at t_1, t_2, t_3, etc. *j* is a two-kilowatt stepup transformer of the open-magnetic-circuit type, furnishing 20,000 volts, with a very low resistance in the secondary. The open-circuit type of transformer is to be preferred for high-tension laboratory experiments, as, in spite of its low efficiency, it greatly lessens the danger of a burn-out with a flaming spark gap. The condenser *C* consists of brass plates separated by glass and immersed in oil. It is divided into four sections, one of which is subdivided into three parts, thus giving a wide range of capacity. Its total capacity is 0.095 microfarad. Of this, however, but one-third or one-half is needed for most experiments. From the condenser, two wires, with the spark gap *S*, and the primary *PP* in series, complete the primary circuit. One of the wires is connected to the innermost end of the spiral, the other to the tap *t*, which by trial gives the best results. This of course will depend on the size of the secondary and the nature of the experiment. The larger the secondary, the more turns will be needed to bring the two circuits in harmony. Whether the grounded wire *E* is to be used or not will depend on the experiment. If, for example, the secondary coil is used as Oudin's resonator, connecting the lower end to the ground greatly increases the effect, but the opposite is true when the apparatus is used as a Tesla transformer. The flat spiral has thirteen turns of No. 0000 cable. The taps are formed by boring holes in this cable and passing a wire through the hole to the front of the table. With this arrangement the effect of tuning may be beautifully shown to an audience by closing the switch of the transformer *j* and drawing one of the leads from the condenser over the entire row of taps. In doing so the discharge of the secondary *H* will rise from a minimum to a maximum and then die out again. The secondary coil *H* is placed in an upright position over the center of the spiral but separated from it by a plate of glass, *G*, the lower end, being always connected to one of the taps, as indicated by the line *K*, to prevent sparking between the primary and secondary. Without this connection a plate of glass even one inch thick will not prevent a heavy discharge passing from primary to secondary. So far three secondary coils of the following dimensions have been constructed:

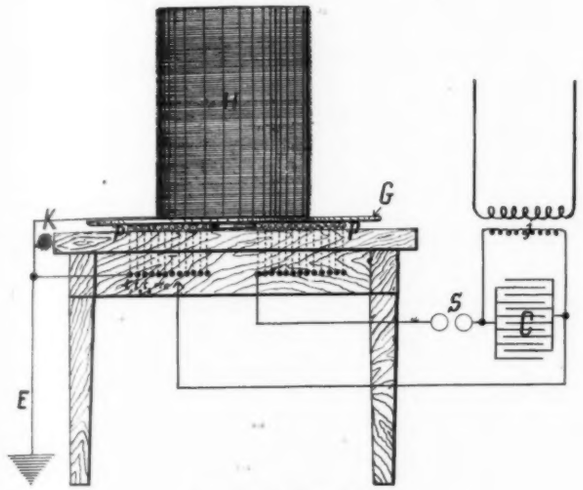


FIG. 1—SIDE VIEW.

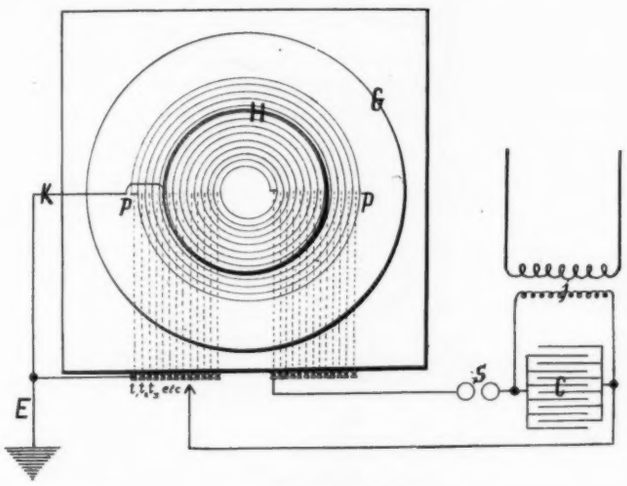


FIG. 2.—PLAN VIEW.

FIG. 3—COIL IN ACTION.

Diameter.	Height.	Number of Wire.	Number of Turns.
16 inches	25 inches	25	900
12 inches	18 inches	28	830
8.5 inches	17 inches	30	986

All three coils consist of a single layer of double-cotton-covered wire boiled in paraffin. The two smaller ones are wound on paper cores, the larger one on a wooden frame. The small coil is tuned with one-third the capacity of the condenser and eight and a half turns of the primary. The next coil with the same capacity of condenser requires ten and a half turns, while the large coil requires with the same capacity an extra impedance coil in series with the spiral.

This modified form of primary *PP* has many advantages, for it not only facilitates experiments with different kinds of secondary coils, but also increases the effects in a marked degree. The small coil, for instance, when con-

nected, as indicated in the diagram, will, after the spark gap has been freshly polished, send out, besides a mass of bluish-white brush discharge, four or five flames which exceed in length the height of the coil, while at intervals one or other will grow in size till it reaches around the glass plate and forms a complete arc from the top of the coil to the primary. However, they are never attracted as one might expect, to the bottom of the coil itself. If the capacity is too great, heavy sparks will break out, mostly from the lower half of the coil. The two other coils give sparks that are of much greater volume though not quite so long. The discharge of all coils is accompanied by noise that will drown out the loudest speaking in the room. Fig. 3 is a reproduction of a photograph of the coil in action, and shows the discharge from the top of the coil. Owing to the color of the discharge at the outer end, which is a red dish purple, this proportion does not show in the photograph, and the discharge appears shorter than it really is.

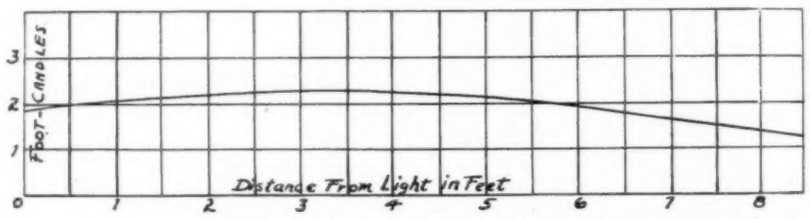
Leveling the Light Distribution by Means of Haskins-Lucida Reflectors.

Thanks to the rapid progress which has been made during the last few years in scientific illumination, exact data is now obtainable as to the distribution of light not only from the lamps themselves but also from the lighting units taken as a whole, i. e., the lamps as aided and modified in their effect by the reflectors, shades or globes used with them. In practice, it is the unit as a whole that gives us the lighting effect by which the consumer profits and for which he has to pay; hence it is from this general effect that he must judge of what he is getting. What that will be, may be estimated to some extent from the rules which have already been determined as to the shaping of globes and reflectors when made of certain materials. But the moment we vary the materials, the rules no longer hold good and new rules or their equivalent in some form or other must be determined for the shades made of the new materials.

This has been particularly noticeable of late in connection with the growing tendency of many prominent architects and engineers to adopt glassware made of a soft pearly type, which will readily lend itself to artistic effects. When such ware is offered to those seriously looking into the problem of economical lighting, two questions are commonly raised: First, does the change to the newer materials mean a loss of light? Second, can a reasonably uniform distribution of the light be obtained by using artistically shaped reflectors made of such pearly material?

As to the first question, all tests so far reported agree that the loss of light by absorption is quite small in the new materials when these are free from specks or cloudy spots which would interfere with the free passage of the light. Moreover, the smooth surface, free from horizontal ribbing, does not afford the lodging places for dust which have made some of the cut-glass types of clear shades difficult to clean. This deposit of dust would have to be taken into consideration in making any comparisons between the two classes of reflectors and shades if such comparisons are to have a commercial value.

As to the second question, curves of light distribution have already been published by the manufacturers for a variety of shapes, but usually these are in the form of bat-wing or butterfly curves which do not convey much meaning to the men who must pay for the light or who must satisfy the user of light that he is getting good value for his money. What these people want to know is, whether or not their using glassware made of the newer materials will still allow them to distribute the light widely and evenly. One answer is given in the curve plotted by the engineering department of the Haskins Glass Company from tests made at the Electrical Testing Laboratories, New York, on a Haskins-Lucida reflector fitted with a 250-watt clear-bulb tungsten lamp. This shows that the foot-candles of light delivered on a working plane eight feet below the source of light are distributed with a remarkable uniformity. Even beyond the six-foot range the light drops off very gradually, reaching the one-foot-candle value at a distance of nine and one-half feet. This chart, as reproduced herewith, represents the light delivered by a single lamp only. Where a number of lamps are suitably spaced so that the rays of light will overlap, they will reinforce each other and produce an illumination in which the variation from an absolute uniformity can not readily be discerned by the human eye. The chart shown is based on tests of a bowl-type reflector, measuring about 12 inches in diameter and 7.5 inches high.



ILLUMINATION ON HORIZONTAL PLANE WITH HASKINS-LUCIDA REFLECTOR.

Gould Storage Battery Car for Pekin, Ill.

A new type of storage-battery car has recently been purchased by the Pekin City Railway, of Pekin, Ill., from the Gould Storage Battery Company, of New York City. This car is operated from the center of the city to the distilleries, a distance of about two miles, and up to the present time is reported to have given the best of satisfaction. It is in service about seventeen hours a day and from 100 to 110 miles are run on one charge.

The car has an overall length of 27 feet; the length of the car body is 18 feet; the length of the platforms is 4 feet 6 inches, and the width of the car body is 7 feet 6 inches. The height from the rail to the top of the car body is 10 feet 4.5 inches. The seating capacity is twenty-eight. The car is propelled through single-reduction gears by means of two series motors rated at thirty amperes, 110 volts. The controllers are of the series-parallel railway type.

The body is placed on a single truck of special design, combining lightness with strength. The car is lighted with tungsten lamps and provisions are also made for heating the car in cold weather. The battery equipment consists of 58 cells, 29 plate, Gould high-capacity batteries of the pasted type. These are placed in a special ventilated compartment under the longitudinal seats. The average speed with 8 stops of 8 seconds each per mile is 7 miles per hour.

Current Electrical News

CANADA.

(Special Correspondence.)

OTTAWA, ONT., DECEMBER 1.—The official announcement is made that the Canadian Light & Power Company, of Montreal, has secured a majority of the stock of the Saraguay Company, which takes with it some important contracts and franchises.

The Dominion Government has granted incorporation to the Eastern Canada Power Company, Limited, of Montreal. Powers are secured to carry on an electric light and power supply business. The capital is placed at $1,000,000.

The Rio de Janeiro Tramway, Light & Power Company has called a special meeting at Montreal for December 11, for the purpose of increasing the capital stock of the company from $40,000,000 to $50,000,000, by the issue of 100,000 additional shares of $100. The net earnings, for the first nine months of the present year amount to $4,956,040, an increase of $1,038,209 over same period last year.

It is stated that within a very short time, the city of Kingston, Ont., will be provided with electric power from the Chats Falls, near Ottawa. There is a proposition now on foot for the city to get its power from High Falls, in North Frontenac, but the distance to Chat's Falls by direct line is only 100 miles, no farther than the High Falls, and only fifteen miles farther than the falls at Waddington, N. Y.

It is said that Sir Max Aitken, the Canadian multi-millionaire member of the British Parliament, and a few of his associates, have a new power project in view. It is stated that application will be made to Dominion Parliament for a charter for a company with a capital of $100,000,000 to develop power on the St. Lawrence River. The scheme will include the Cedars, Cascades and the Coteau Rapids, and the aim is to provide for the development of an enormous amount of power. The promoters claim that these rapids, being all in Canadian territory, will simplify matters very much. This is the project whereby it is proposed to promote a company having an initial capacity of 1,000,000 horsepower, and an ultimate capacity of 5,000,000 horsepower.

The new hydraulic development at Shawinigan Falls, Que., of the Shawinigan Water & Power Company, which provides for 75,000 horsepower for use in the city of Montreal, has been completed for some weeks. This development involves an enlargement of the canal and bulkhead, from which five penstocks of 15,000 horsepower each, will be eventually carried to a separate power house now erected, and in which are presently installed two complete units of 15,000 horsepower each, together with a new steel-tower transmission line operating at 100,000 volts, and an entirely independent terminal station at Maisonneuve, at the Montreal end of the line. During the past two weeks this plant has been thoroughly tested by the Shawinigan company and gives the utmost satisfaction. It is worthy of remark that this plant now makes the Shawinigan company's development the largest single development in Canada, as no one company at Niagara has reached the total capacity of the Shawinigan plant.

In two years' time, there will be another competing company in the electric lighting and power field of the city of Montreal and surrounding district. The Cedar Rapids Manufacturing & Power Company, of which D. Lorne McGibbon is the head, and Henry Holgate, consulting engineer, both of Montreal, is to deliver power in that city early in 1914, commencing with an initial supply of 50,000 horsepower. The ultimate cost of the development work will be upwards of $10,000,000, and when all is complete, 150,000 horsepower will be available to the users of electricity in Montreal and surrounding district. The Cedar Rapids is but twenty-eight miles from the city, and it is stated by Mr. Holgate, who is in charge of the engineering features of the project, that the cost of production and transmission to the city will be comparatively low and that the company will be in an excellent position to deliver power there at greatly reduced prices. The Cedars Company has already obtained the necessary authority from the Dominion Government and the work will be proceeded with at once.

The first inventory ever taken of the water powers of Canada has been completed by the Conservation Commission of Canada, of which the Hon. Clifford Sifton is the chairman. The investigation made by the Commission, which has extended over a period of two years, shows that there is 1,016,521 horsepower developed from water power in Canada. The power situation in Ontario is treated very fully, special attention being given to the power possibilities at Niagara and condition affecting development there. A significant reference is made to the granting of franchises to develop power at Niagara Falls. The report states that the low-water flow of the Niagara River would yield, at the Falls, about 2,250,000 horsepower, of which Canada's share would be one-half. Franchises have already been granted and plants partially completed for the development, on the Canadian side of the river, of about 450,000 horsepower. In other words, instead of "millions" of horsepower being available, as has been sometimes stated, it appears that one-half, and by all odds the better half, of Canada's usable share of Niagara Falls power, has already been placed under private control. Ontario leads all the other provinces in electrical development, the total amount developed in this province being 532,266 electrical horsepower, while Quebec comes next with 300,153 horsepower. The report says that it has not been deemed advisable to make an estimate of the total water power in the country, but mention is made that one estimate places it at 17,000,000 horsepower. Canada has an estimated water area of 125,755 square miles. Hence, as compared with the estimated area of 52,630 square miles of water area in the United States, Canada is seen to have nearly two and a half times the water area possessed by the United States. The estimated water area of Ontario alone is 40,354 square miles, exclusive of any portion of the Great Lakes, or any arm of the sea.

MEXICO.

(Special Correspondence.)

MEXICO CITY, MEX., NOVEMBER 29.—Official announcement is made that the Mexican Midland Light & Power Company, Ltd., of Montreal, Can., which was recently chartered with a capital of $45,000,000, has acquired the concessions and other holdings of the Mexican Hydroelectric Company which had its headquarters in Mexico City. This new company will, it is announced, carry out the plans of the Mexican Hydroelectric Company for the installation of hydroelectric plants on the Waranjo River in the state of San Luis Potosi and the Rio Blanco in the states of Nuevo Leon and Tamaulipas. Besides the available water power that is owned by the company its concession from the Federal Government called for the construction of systems of electric railway and several hundred miles of power transmission lines.

With regard to the construction of a dam on the River Conchos, State of Chihuahua, to store the flood waters of the river up to 1,109,000,000 cubic meters, for the generation of electric energy, the *Mexican Herald* states that more than 1,000 men are at work on the dam and reservoir, which will be completed by June, 1913. The power generated will be transmitted to the Parral, Naica, Santa Barbara, Santa Eulalia, and other mining districts of Chihuahua. Water will be stored along the course of the Conchos for a distance of thirty miles, the reservoir varying in width from four to five miles. The total cost of the work is estimated at about $7,650,000. The undertaking is being carried out by the Mexican Northern Power Company, a Canadian concern.

Capital is now being sought for the erection of an electric plant at the Talamantes cotton factory at Allende, District of Jimenez. At present about sixty horsepower is developed from the waters of the natural spring called Ojo de Talamantes. The cotton factory controls only about one-half of the power during the working days, but has exclusive water rights at night and during feast days. Should the money be secured, the owners plan the erection of a $50,000 plant which will develop about 100 horsepower.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, has authorized the Richfield Springs Utility Company to purchase the existing plant and distributing system of the Richfield Springs Electric Light & Power Company and to increase its capital stock from $300 to $20,000. The company is also authorized to make a mortgage upon all its property and franchises to secure an authorized issue of $100,000 par value of five-per-cent first-mortgage thirty-year gold bonds. The company is authorized to issue capital stock to the amount of $13,600 and bonds to the amount of $34,000, to be sold at not less than eighty-five for the purchase of the properties mentioned and for rehabilitation of the plant at Richfield Springs.

The Public Service Commission, Second District, has closed upon its records the complaint made by residents of Warsaw against the American Express Company and the Wells Fargo & Company Express as to the refusal of each of these companies to install a telephone of the Federal Telephone & Telegraph Company in local offices in that village. Upon a hearing had upon the complaint the companies have agreed to install the Federal service for a period of six months to ascertain the need of the same.

At Albany on Monday the complaint of the residents of Coxsackie against the Upper Hudson Electric Company as to the price for electricity and alleged discrimination against that village was heard; also the petition of the Northern Westchester Lighting

Company for authority to issue bonds; a hearing upon an order to show cause made by the Commission as to the manner of keeping accounts by the Westchester Lighting Company; and an order to show cause directed against the Ticonderoga Home Telephone Company and the Ticonderoga Light, Heat & Power Company as to why certain additions, improvements and alterations should not be made to their plants, so that they may improve their service for the public use.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

A 100,000-HORSEPOWER PLANT PLANNED.—The Great Northern Railroad Company is preparing to develop 100,000-horsepower by building a dam and hydroelectric plant in the gorge of Chelan River, which connects Lake Chelan, in Washington, with the Columbia River. The dam will raise the level of Lake Chelan, already famous as the deepest lake in the world. Two dam sites are under consideration by Robert Herzog of St. Paul, who built the Great Northern's small hydroelectric plant in the Tumwater Canyon of the Wenatchee River, by which trains are operated through the Canadian tunnel. Chelan dam will be either 200 or 300 feet high, depending on which site is used.

NORTHERN CALIFORNIA COMPANY'S PLANT STARTS.—The new 21,000-horsepower hydroelectric plant of the Northern California Company, at Coleman, on Battle Creek, was recently put in operation. The powerhouse, the machinery contained therein, the eleven miles of canal to convey 20,000 miners' inches of water, and the other equipment, cost nearly $1,000,000. The new plant almost doubles the company's development, which now totals 47,000 horsepower, the other four plants combined developing only 26,000 horsepower. This power is distributed down the valley as far as Chico on the east side of the river and Arbuckle on the west side, the surplus being delivered in San Francisco over the wires of the Pacific Gas & Electric Company. The Northern California Power Company has commenced work on a far larger undertaking in the big bend of Pitt River, where 100,000 horsepower will be developed at a cost of $4,000,000. This work is to be completed in two years.

LIGHTING AND POWER.

(Special Correspondence.)

GRAVETTE, ARK.—This city is to issue $25,000 in electric light bonds.

MENLO, IOWA.—A vote will soon be taken on granting an electric light franchise. C.

MARQUETTE, NEB.—It is contemplated to install a combination water and light plant. C.

CORPUS CHRISTI, TEX.—The municipal electric light system is to be extended and improved. D.

GLIDDEN, IOWA.—The proposition carried to issue bonds for $10,000 for an electric light plant. C.

NORFOLK, NEB.—This city will vote December 12 on the issuance of $75,000 in electric light bonds.

DALLAS, TEX.—The Hancock Electric Company has been incorporated with a capital stock of $6,000.

PERRY, IOWA.—The Perry Electric Company has been incorporated with a capital stock of $100,000.

DALLAS, TEX.—The Dallas Electric Light & Power Company is about to double the capacity of its plant.

WASECA, MINN.—The Consumers Power Company, of Mankato, will furnish light and power for this place. C.

WAGONER, OKLA.—The Wagoner Electric & Gas Company has been incorporated with a capital stock of $1,500.

STORY CITY, IOWA.—A contract has been closed for the installation of sixty-five electroliers along Broad Street. C.

HOT SPRINGS, CAL.—The Pine Flat Company plans for the erection of an electric power plant near Hot Springs. A.

WAKONDA, S. D.—The Wakonda Light, Power & Heating Company has been formed and will install a lighting plant. C.

MENNO, S. D.—An electric light plant is to be installed here soon. Arrangements have been made for putting it in. C.

ASHDOWN, ARK.—The Texarkana Ice Company has been granted a twenty-five-year electric light franchise here.

ALLEGHANY, CAL.—The Twenty-one Mine, F. M. Phelps, manager, plans for the installation of an electric power plant. A.

LETHBRIDGE, ALTA.—On December 11, the city will vote on $450,000 for a municipal street railway and power system. C.

BLUE HILL, NEB.—The Webster County Light & Power Company has been incorporated with a capital stock of $4,000.

ALLISON, IOWA.—The question of granting a twenty-five-year franchise to Claude Mackey will be voted on December 11.

STEAMBOAT ROCK, IOWA.—The proposition has carried to grant the Park Dam Company a franchise for electric lights. C.

SLATER, IOWA.—The Commercial Club has appointed a committee to investigate the matter of installing ornamental street lights. C.

LAKE CRYSTAL, MINN.—The Consumers' Power Company, Mankato, Minn., seeks a franchise here to furnish electric light and power. C.

KEOKUK, IOWA.—Sample electroliers are being placed on several streets to give the business men an opportunity to select their design. C.

WABASHA, MINN.—The Minnesota & Wisconsin Power Company is building a power line, via Red Wing, through Lake City to Wabasha. C.

HUNTINGTON, ORE.—A franchise has been granted the Oregon-Idaho Light & Power Company for an electric lighting system in this city.

GARDINER, ME.—The Central Maine Power Company has built a line to Richmond and is now supplying that town with current for lighting.

PANDANARUM, MASS.—Through a popular agitation electric lights are to be installed here, although service will not be started until spring.

BOWBELLS, N. D.—The proprietor of the Portal electric light plant has asked for the privilege of operating an electric light plant here. C.

BALTIMORE, MD.—A plant will be installed for lighting and heating the City Hall and Courthouse. The installation will cost about $70,000.

VAN HORNE, IOWA.—Work is being pushed on the light power building, and it is thought the plant will be in operation about December 25. C.

SINTON, TEX.—The Sinton Ice & Light Company has been incorporated with a capital of $10,000 by L. Fonts, R. N. Hodge and Gordon Bullitt.

SAN DIEGO, CAL.—The plans of Superintendent Adams to light the down town streets with ornamental cluster lights have been approved.

ELK GROVE, CAL.—The Pacific Gas & Electric Company plans for the installation of an incandescent electric street-lighting system at Elk Grove. A.

WENATCHEE, WASH.—The Wenatchee Valley Gas & Electric Company has purchased the plant of the Valley Power Company at Dryden for $250,000.

KAMLOOPS, B. C.—The municipality is considering the erection of a hydroelectric power plant of 2,000 horsepower capacity on the Barrier River. A.

MANCHESTER, IOWA.—A five-year contract for lighting the streets of this city has been made with the Manchester Light, Heat & Power Company.

HOLLAND, IND.—The Home Electric Light Company has been incorporated by J. H. Miller, H. W. A. Hemmer and J. F. Oberbeck. The capital is $1,500.

SIOUX CITY, IOWA.—The Electric Engineering Company has been incorporated with a capital of $10,000 by E. L. Snyder, Harry J. Ryan and Ralph A. Oliver.

OTTERBEIN, IND.—The Otterbein Light & Power Company has been incorporated by R. H. Holt, Lewis Leaming and R. W. Pierce. The capital is $10,000.

ANGOLA, IND.—The Angola Light & Power Company has been incorporated with a capital of $50,000 by John Dreibeliss, W. E. Mossman, A. J. Vesey and others.

NEWTON, MISS.—An ordinance has been passed consolidating the municipal electric light and waterworks plants. H. O. McCord has been chosen as superintendent.

BERKELEY, CAL.—Mayor J. Stitt Wilson has proposed that the city establish its own lighting plant, and a committee has been appointed to look into the matter.

GOODING, IDAHO.—The electric substation of the Great Shoshone & Twin Falls Power Company, of Boise, was destroyed by fire. The staton will be rebuilt. A.

FORT DODGE, IOWA.—The Fort Dodge, Des Moines & Southern Interurban plans an increase of voltage from 600 to 1,200. Various improvements will be made. C.

LAUREL, MISS.—The Laurel Electric Light & Power Company has been chartered with a capital of $75,000 by P. H. Saunders, S. M. Jones and Herbert Lampe.

PERRY, IOWA.—The Perry Electric Company, with a capital of $100,000, has recently been incorporated. B. C. Dilenbeck, J. E. Hambright and C. E. Wilson are directors.

PRESCOTT, ARIZ.—The Arizona Power Company plans for the construction of a new transmission line to the Copper Basin mining district. R. S. Masson is engineer. A.

KEARNEY, NEB.—A special election is to be called for the purpose of taking a vote on the issuance of $40,000 to be spent in building and equipping an electric light plant.

THORNDALE, TEX.—The Thorndale Water Company has changed its name to the Thorndale Water and Light Company and increased its capital stock from $10,000 to $40,000 for the purpose of installing an electric light plant. D.

EPHRATA, WASH.—The Ephrata Electric Company is being formed for the purpose of furnishing electric light for this city.

The company has a capital of $10,000 and will incorporate and proceed at once with installing a plant.

MADISON LAKE, MINN.—It now appears certain that electricity for light and power will be transmitted from Rapidan. The matter of a franchise is soon to be discussed.

GOLDENDALE, WASH.—County Commissioner Barnes plans for the erection of an electric power plant on his ranch property on the Little Klickitat Creek, near Goldendale. A.

TWO HARBORS, MINN.—The City Clerk is taking bids for installing a new engine to replace the one in the city power plant which was wrecked and broken in an accident. C.

PITTSTON, PA.—There has been considerable agitation here recently in regard to purchasing the plant of the local electric light company and operating it as a municipal plant.

CASTLE ROCK, WASH.—The Council has granted to H. B. Davies, J. W. Seldon and the Tacoma Investment Company the right to construct and operate electric lines within the city.

WALLA WALLA, WASH.—A fifty-year franchise has been granted the Pacific Power & Light Company for setting poles and stringing wires over the streets and alleys of Atalia.

CENTRALIA, WASH.—The Washington-Oregon Corporation has made application for a franchise to erect poles for electric light wires along the country road between Littell and Adna.

DORRIS, CAL.—The bid of the Siskiyou Electric Light & Power Company for a franchise for stringing and maintaining wires in the corporate limits of the town of Dorris has been accepted.

RED WING, MINN.—The Red Wing Gas, Light & Power Company has been asked to submit a proposition for the lighting of the city under a new contract, including cluster lighting. C.

HAILEY, IDAHO.—Kilpatrick Brothers plan for the erection of a hydroelectric power plant on Silver Creek. A power and lighting distributing system will be installed at Picabe, Idaho. A.

BOISE, IDAHO—The VanWick Light & Power Company has been incorporated with capital stock of $100,000. The stockholders are L. Kimball, M. E. Wayland, M. R. Jones and W. C. Clark.

MORRIS, MINN.—S. Stewart recently purchased a 250-horsepower engine for the electric light plant. A new generator has also been purchased and both will be installed in the plant. C.

FAIRBURY, NEB.—The Council rejected the new turbine engine and dynamo, recently purchased, to add to the electrical equipment of the city plant, because they were considered too small. C.

WASECA, MINN.—The City Council has sold $15,000 of bonds for the city's water and light uses. The power and light circuits are to be rebuilt and new generators added for the day circuit.

SIOUX CITY, IOWA.—A local company has been organized at Dakota City for the purpose of putting in an electric light and power plant which will furnish light and power for the entire city.

SANTA ANA, CAL.—The Board of City Trustees and the Merchants' & Manufacturers' Association plan for the installation of an ornamental cluster street-lighting system in the business district. A.

ABERDEEN, S. D.—The Aberdeen Light & Power Company have been notified by the City Commission to put its plant into shape to give adequate service and comply with terms of the franchise. C.

FRESNO, CAL.—According to General Manager A. G. Wishon, of the San Joaquin Light & Power Company, the survey work of the proposed line near Edison and fourteen miles south is almost completed.

WILLIMANTIC, CONN.—A resolution has been adopted providing for a committee to enter into a three-year contract with the Willimantic Gas & Electric Company. The present contract expires in January.

BEAUMONT, TEX.—Articles of incorporation of the Beaumont Electric Light Company have been recently filed. The capital is $880,000. Practically all of the stock is owned by Raymond Neilson, of Houston.

SALT LAKE CITY, UTAH.—F. Auerbach & Brothers will build an electric power plant in connection with their new department store. A building permit for the erection of the power house has been issued. A.

EDGEFIELD, S. C.—The town of Edgefield is now engaged in putting in an electric lighting plant. Contracts for the erection of the central power house have been let and the work will be pushed to completion.

LOUISVILLE, KY.—The Marine Electric Company, capitalized at $5,000, has filed articles of incorporation, and will do repair work. The incorporators are E. C. Thirwell, H. A. Tepel and C. G. Thirwell.

VICTORIA, B. C.—Alexander Watson, shipbuilder, is preparing plans for a new steamer to be constructed by the British Columbia Express Company. The plans call for the installation of an electric lighting plant. A.

EUFALA, ALA.—Contracts have been awarded for the construction of the new municipal electric light plant, the total cost from the boilers to the distributing system to be $25,229. It is expected that the new plant will be ready for operation in about four months.

VISALIA, CAL.—The Mount Whitney Power Company plans for the installation of a street-lighting system at Visalia in the business and residential districts. General Manager Maddox is in charge of the work. A.

SYRACUSE, KANS.—Work is under way on the new $40,000 municipal water and electric light plants that have been contemplated for some time. It is expected that service will be started in about three months.

GLENDALE, CAL.—The city trustees have accepted the offer of L. C. Brand to transfer the Glendale Light & Power Company's West Glendale system to the city for $55,000. The system will be enlarged and improved.

ATTALIA, WASH.—Poles are being erected for the distribution line distributing electric power over the local irrigation project. Attalia will have electric lights by January 1. Work on the pumping plant is being rushed.

DEFIANCE, O.—The Defiance Utilities Company has been incorporated with a capital of $50,000 to operate an electric light plant. The incorporators are M. W. Steinberger, H. D. Bokop, E. W. Costello and C. S. Ashley.

BLOOMFIELD, N. J.—The City Council has authorized the mayor to sign a lighting contract for a term of five years with the Public Service Electric Company. The idea of erecting a municipal plant has been abandoned.

DEVILS LAKE, N. D.—The Stotler Investment Company has taken possession of the Devils Lake & Chautauqua Railway, which it recently purchased. Work will be started, preparing for electrification as soon as possible.

SUTTON, MASS.—This town is to be furnished with electric power by the Worcester Suburban Electric Company. The city waterworks will be electrically operated, and a number of residences supplied with electric light.

OLDENBURG, IND.—The Oldenburg Electric Light, Power & Waterworks Company has been incorporated with a capital of $5,000. The incorporators are George Holtel, N. G. Gloshen, Harry G. Barchelt, B. J. Kessing and John Schmidt.

VIRGINIA, MINN.—At a recent election it was voted that the city should acquire by purchase or by condemnation the water and light plant of the Virginia Electric Power & Water Company and operate the same for the benefit of the public.

EUGENE, ORE.—The City Council has sold the $25,000 bond issue for a street lighting system, recently voted, to local people. The city will soon commence the installation of the system, which provides for cluster standards on the main streets. A.

WASHTUCNA, WASH.—L. Campbell plans for the erection of a hydroelectric power plant on the Adams River, with a transmission line to the flour mill plant he proposes to establish. The power generated will be used for operating the mill. A.

FAIRFIELD, IOWA.—The City Council, of Fairfield, has signed a contract with the officials of the Iowa Power Company, at Oakland Mills, for light to be furnished the city at three cents a kilowatt-hour. The contract is for a period of ten years.

FLANDREAU, S. D.—At a special election at Flandreau the voters gave their approval to an electric light franchise which had been submitted to them. The work of installing the plant will be commenced as soon as the preliminaries can be arranged.

ANOKA, MINN.—Preliminary work on a big dam has been begun by the Great Northern Developing Company, of Duluth, Minn. The dam will be of concrete and will generate 10,000 horsepower. The new dam is situated about five miles southeast of Anoka. C.

PATTON, CAL.—The State Engineering Department has approved the plans as prepared by State Engineer Ellery, Sacramento, for the erection of a power plant at the Southern California State Hospital at Patton. The plant is estimated to cost $12,000. A.

HOBART, OKLA.—The plant of the Hobart Light & Power Company, operating the local electric light plant, has been sold under direction of the United States Court to satisfy a judgment in favor of a Denver bank. W. S. Huff, of Denver, bid in the plant for $85,500.

JANESVILLE, WIS.—The Janesville Electric Company has closed a contract with the Allis-Chalmers Company, of Milwaukee, for a 500-kilowatt turbine generator with switchboard, etc. The new machine will be installed at the upper plant near the Fourth Avenue bridge.

GALVA, IOWA.—I. E. Baumgardner, town clerk, will receive bids until December 15 for the erection and installation of the buildings and the plant of an electric light system. A check for $500 must accompany each bid. The Electric Engineering Company, Sioux City, Iowa, engineers.

EATON, O.—A twenty-five-year franchise to maintain an electric power-transmission line in Preble County has been granted the Greenville Electric Light & Power Company. The company will furnish electricity for light and power in the villages of Lewisburg, West Manchester and Eldorado.

STANDISH, MICH.—C. F. Hall, proprietor of the City Flour & Shingle Mills, has become sole owner of the local electric light plant and waterworks. A new power house will be erected, and the plant moved to the grist mill property. A ten-year franchise for city lighting and pumping will be asked for.

GUTHRIE, OKLA.—The city will issue light bonds and proceed with the building of the municipal electric light plant, following a recent decision of the Federal Court. The Woodward Cotton Company has a contract with the city to furnish light and attempted to restrain the city from building the municipal plant.

TACOMA, WASH.—The Castlerock Light & Power Company has been incorporated with a capital stock of $250,000 and principal office at Tacoma. H. B. Davis, A. E. Braden and I. W. Seldon are incorporators. The company will build an electric lighting plant and distributing system at Castlerock, Wash. A.

MINNEAPOLIS, MINN.—The city engineer has been instructed to prepare estimates as to the cost of installing an electric generating plant at the new filtration installation. Should this plant be installed the machinery at the filtration plant, including pumps, etc., will probably all be driven by power generated there.

GEORGETOWN, TEX.—The city water and light plant improvements, aggregating $45,000, are nearing completion. The light plant is now in operation. Street lights numbering 100 have been put in recently. Already 100 residences have been wired and others will follow in addition to the 400 already having the lights.

BURLINGTON, VT.—The contract for the new turbine generator and condenser to be installed in the municipal lighting plant has been awarded to the Westinghouse Electric & Manufacturing Company for $20,500. The estimated cost of putting the plant in operation and placing it on a paying basis is estimated at $24,000.

WASECA, MINN.—The city has made a contract with the Consumers Power Company for power at a flat rate of four cents per kilowatt-hour. The power will be used for city lighting and city pumping, and in addition the city will retail it to private users. A bond issue of $15,000 will be used in rebuilding the distributing system, etc.

OTTUMWA, IOWA.—The Ottumwa Gas, Light, Heat & Power Company, which has been owned by local parties, was recently sold to the Western Utilities Company, controlled by Grand Rapids, Mich., and Chicago capitalists. The company will be reorganized and an issue of $750,000 of bonds floated for extensions and improvements.

PINE CITY, MINN.—The Eastern Minnesota Power Company is installing a hydroelectric power plant seven miles east of here, on the Snake River. The plant will be equipped with modern electric and hydraulic machinery. The first installation will be about 1,000 horsepower. Approximately 100 miles of power lines will be built. C.

DEL RIO, TEX.—It is announced by D. B. Chapin of San Antonio, who is promoting the construction of a dam across Devil's River above here to provide the initial power for a large hydroelectric plant and water for irrigating about 125,000 acres of land, that he is making good progress with his plans. The project will cost about $2,000,000. D.

HOLLAND, IND.—Articles of incorporation have been filed by the Home Electric Light Company, of Holland. The capitalization is $15,000. The object of the company is to build, equip and operate a plant for the furnishing of light and power for the town of Holland. John H. Heitinan, J. H. Miller, Harry W. A. Hemmer and J. Frank Overbeck are interested.

JANESVILLE, MINN.—The Village Council has granted a franchise to the Consumers' Power Company of Mankato to light this village. This company owns and operates a large power house at Mankato. It will extend its lines and furnish Janesville with electricity for lighting and power. The company will also pump water for the village water system.

PLAISTOW, N. H.—This city is to be electrically illuminated, power being supplied from the plant of the Haverhill Electric Company of Haverhill, Mass. The Haverhill company will transmit power at 2,300 volts to the state line at which point it will be taken over by the Plaistow Electric Light & Power Company. The latter company own all the equipment in Plaistow and will retail the power.

TRAVERSE CITY, MICH.—Articles of incorporation have been filed by the Duck Lake Power Company, which has been organized for the purpose of generation, distribution and sale of electricity for lighting, power and general purposes. The capital stock is $16,000. The incorporators are Harlin Brown, David E. Wynkoop and Ralph Wynkoop. The assets of the company include 140 acres of land at the outlet of Duck Lake.

VISALIA, CAL.—The Pacific Light & Power Corporation, Los Angeles, has been granted a franchise by the Board of Supervisors for the erection of power transmission lines in Tulare County. The company has signed a contract with the Stone & Webster Engineering Corporation, Boston, for the construction of its proposed hydroelectric power plant at Big Creek, Fresno county. G. O. Newman is engineer in charge.

ATLANTA, GA.—The Georgia Railway & Power Company has been incorporated to lease for 999 years the property of the Georgia Railway & Electric Company and to develop big water-power facilities in the neighborhood of Atlanta. The company will have an authorized capital of $30,000,000 bonds and $27,000,000 stock. It will not only lease but will guarantee the dividend on the Georgia Railway & Electric Company's property.

REDDING, CAL.—The Mount Shasta Power Company has filed a waiver on the part of the Central Pacific Railway Company in consideration of $12,000 to provide for all damages that may accrue to the railroad property by the diversion of water in the Big Bend of the Pitt River. The Mount Shasta Power Company will build a hydroelectric power plant with a generating capacity of 200,000 horsepower. The plant is estimated to cost $7,000,000. A.

BEAUMONT, TEX.—The Beaumont Electric Light & Power Company has been organized with a capital of $880,000 to do a general public and private electric light and power business. The incorporators are C. W. Kellogg, Jr., Dallas; E. J. Emerson, Beaumont, and Marshall M. Phinney, Boston, Mass., and they are directors for the first year, with L. C. Bradley, of Galveston, David Daly, Harry L. Harding and W. A. Stevens, of Houston.

BIRMINGHAM, ALA.—The Tidewater Company, that is now constructing a street car line from East Lake to Ensley, has submitted a proposition to the city to furnish electric lights to the city and its citizens. It is understood that in this proposal the Tidewater Company agrees to furnish lights at a cheaper price than is proposed in the proposition of the Birmingham Railway, Light & Power Company, now pending before the Commission.

WEYMOUTH, MASS.—An appropriation of $60,000 to be used in making extensive improvements and additions was voted at a recent meeting of the stockholders of the Weymouth Light & Power Company which supplies the municipal plant of Hingham. The additions to the present plant come as the result of a large growth in the business in Weymouth, Hingham, and Hull. The improvements will include the installation of a 1,000-kilowatt-steam turbine.

ANGOLIA, IND.—The Angolia Light & Power Company has filed articles of incorporation. The capital stock is $50,000, divided into 500 shares of $100 each. The object of the corporation is to promote, finance, construct, rent and operate street and interurban railroads and power plants. John Dreibiss, W. E. Massman, Allen J. Vessey, D. M. Vessey and W. J. Vessey, all of Ft. Wayne, Ind., and Eugene S. Reilly and M. B. Kelly, of Pittsburg, Pa., are the incorporators and directors. S.

GARY, IND.—The Gary & Southern Railroad Company has contracted with the Gary Heat, Light & Water Company for electric power for a period of five years. This means as soon as the tracks are laid and the wires strung the road will go into operation without delay between Crown Point and Gary. This is the first time the Gary power concern has made a contract outside of the city and its rule was waived because the Crown Point line is badly needed. S.

GLENDALE, CAL.—The offer of the Glendale Light & Power Company to sell the municipal electric lighting plant its system in West Glendale for a consideration of $55,000 has been accepted by the Board of Trustees. The city will vote bonds for the payment. The system will be extended to new territory and improved. Work will start at once upon the ornamental street lighting system to be installed on Brand Boulevard, Fourth Street and Glendale Avenue. The system will comprise five-light cluster standards, spaced at intervals of 150 feet. A.

SUNBURY, PA.—The property of the Middlecreek Electric Company has been transferred to the Northumberland Gas & Electric Company. The property includes the waterpower plant, two miles south of Selinsgrove, all the land bought for dam purposes, the mill and water power at Kratzerville, and the steam plants in Sunbury and Northumberland. The consideration is $223,500. The consolidated company now owns all the gas and electric plants in Sunbury, Selinsgrove, Northumberland and Milton; has a ninety-nine year lease on the Lewisburg plant and an option on the property of the Middleburg Light, Heat & Power Company.

SPRINGFIELD, MASS.—Plans are being drawn for extensive improvements on the electric light plant of this city. Work will be started as soon as possible.. As finally completed the plant will have normal capacity of 1,550 kilowatt. This will be generated by two 500-kilowatt machines, one of 350-kilowatt capacity and one of a capacity of 200-kilowatts. The present plant was inadequate to the demands of the city and at one time during the past month the breaking down of one of the machines forced the lighting department to keep portions of the city in darkness until the commercial plants which are supplied were closed down and their power could be transferred to the lighting department.

SAN FRANCISCO, CAL.—The Oro Electric Corporation has been incorporated with a capital of $10,000,000; headquarters at San Francisco. The company is a subsidiary of the Oro Water, Light & Power Company, and is incorporated with the following directors: F. V. Pering, F. S. McAllister, W. B. Phelps, W. S. Wisley, A. Harvey and W. G. Jack. The corporation has executed a mortgage in favor of the First Federal Trust Company, of San Francisco, to provide for its bond issue of $10,000,000, recently voted The funds will be appropriated for the construction of the proposed 50,000-horsepower hydroelectric power plant in Humbug Valley, Plumas County. A.

ELECTRIC RAILWAYS.

(Special Correspondence.)

LOS ANGELES, CAL.—E. D. Godde, C. P. Grogan and T. Miller are projecting a railway line for San Fernando, to be built under the direction of the Mission Land Company.

WINAMAC, IND.—James C. Fletcher and associates, of Indianapolis, are promoting a traction line to connect Monticello, Knox, Winamac, Wanatah, Bass Lake and Valparaiso. S.

BLAINE, WASH.—The City Council has granted the Nooksack Valley Traction Company an electric railway franchise on certain streets of the city. J. E. Morrison is manager of the company.

EL PASO, TEX.—A bonus of $16,000 has been raised by the El Paso Electric Company to build an electric car line along North Stanton Street from Arizona to San Antonio Street.

QUINCY, ILL.—It is understood that arrangements have been completed to finance the projected interurban line which is to be run from Quincy to Niota. H. F. Dayton is interested. C.

PASADENA, CAL.—The Board of Supervisors will receive sealed bids up to December 26 for a forty-year franchise to operate an electric railroad along certain highways of Pasadena.

BAKERSFIELD, CAL.—The San Joaquin Light & Power Company has been granted a forty-nine-year franchise for a street railway on Chester Avenue from Twenty-fifth to Thirty-fourth Street.

BROWNSVILE, TEX.—S. A. Robertson, of San Benito, Tex., who has the franchise for constructing a street-railway system here, is preparing to start work. The lines will traverse the principal business and residence streets. D.

RICHMOND, IND.—A survey of the route of the Richmond & Eastern Indiana Traction Company from Richmond to Portland is progressing rapidly under the superintendency of Jessup and Moore. The plan is to let the contract for early spring construction. S.

DALLAS, TEX.—The Commissioners' Court has granted John T. Witt a franchise to construct an interurban electric railway from the west bank of the Trinity River to a point ten miles west in the county. The proposed line will traverse a thickly populated section. D.

GREENVILLE, TEX.—The City Council has granted a franchise to Joseph F. Nichols for the construction of an electric street railway line through the city. This line is to be a part of an interurban railway which Major Nichols and associates will construct. D.

CONNERSVILLE, IND.—The Merchants Interurban Railway Company, of Richmond, is proposing to build a road to connect this city and Milton with the Richmond and Portland road. The outlook for traction development in eastern Indiana during 1912 is very bright.

LOS ANGELES, CAL.—At a meeting of the stockholders of the Pacific Electric Railway Company a bond issue of $100,000,000 was voted. The issue will provide for the underlying bonds of the various subsidiary companies and to allow funds for extensive construction and improvement work. A.

RICHMOND, IND.—The Eastern Indiana Traction Company, has entered upon the work of making a detailed survey for the construction of a line south from Richmond to Hamilton, O., and Northeast from Richmond to Portland, Ind., a distance of eighty-five miles. Work will begin early in the spring. S.

NEW ORLEANS, LA.—It is announced by B. F. Yoakum of New York, chairman of the Frisco committee and board, that the Louisiana Southern Railroad which now belongs to the Yoakum interests is to be electrified. Its total length will be about seventy-five miles, running from New Orleans through a very populous territory. D.

SACRAMENTO, CAL.—The Fresno & Eastern Railway Company has been incorporated with a capital of $1,500,000 to build an electric railway from Fresno to Shaver, Cal., a distance of seventy-eight miles. Fayette M. Meigs, Oakland, Albert B. Dodd, San Francisco, and George A. Aldrich, Audubon, N. J., are incorporators. A.

HAMMOND, IND.—Senator Gavitt, president of the Gary & Interurban Railroad Company, and C. D. Emmons, general manager of the Chicago & Northern Indiana Traction Company, announce that negotiations are almost completed which will give the latter road an entrance into Hammond, and ultimately into Chicago. S.

COVINGTON, LA.—W. J. Tracy, of Cleveland, O., has been granted a franchise for the construction of an electric railway from Slidell to Houltonville, St. Tammany Parish. It is said that this line is a link in a proposed electric road between Slidel and Hammond, and that it will be extended to Baton Rouge. Mr. Tracy is the head of a syndicate of Cleveland capitalists.

CANON CITY, COLO.—The Arkansas Valley Railway, Light & Power Company was recently incorporated with a capital of $10,000,000 by F. W. Insull, T. H. Devine and W. S. Raber, all of Pueblo. The purpose of the corporation is to construct a network of electric transportation lines out of Pueblo to connect all of the more important towns on the Arkansas Valley from Canon City as far east as Rocky Ford and La Junta.

INDIANAPOLIS, IND.—The Southwestern Traction Company, with headquarters in Indianapolis, has filed articles of incorporation with the Secretary of State, with $50,000 capital stock. The proposed line will extend from Mooresville, Morgan County, through Cloverdale, Cataract, Clay City, Terre Haute, to Sullivan, in Sullivan County. John W. O'Hara, Joseph A. Davidson, Gilmer Bray, John A. Johnson and Frank F. James, all of Indianapolis, are directors of the new company. S.

SACRAMENTO, CAL.—Articles of incorporation of the Sacramento & Eastern Railway have been filed. The road is to extend from Sacramento to Folsom and is incorporated for $1,000,000. The incorporators are Charles H. Hammon, of Berkeley; Leon J. De Sabla, of San Francisco; Samuel Lillenthal, of San Francisco; George E. Springer, of Oakland, and Herbert W. Furlong, of Pleasanton. The road will be about sixty miles in length and will parallel the Southern Pacific Railroad.

OAKLAND, CAL.—The United Properties Company, a Delaware corporation, has filed articles of incorporation with a capital stock of $200,000,000; headquarters at Oakland. The company operates the Key Route electric railway system and other electrical properties, and plans for the construction of a new line from Oakland to Sacramento. Frank Smith, C. B. Seabrushie, H. R. Ewart and H. W. Davis are incorporators. A.

SACRAMENTO, CAL.—The Sacramento & Eastern Railway Company has been incorporated by officials of the Northern Electric Railway Company with a capital of $1,000,000. The road is organized for the purpose of building a line from Sacramento to Folsom, by way of Fair Oaks and Orange Vale, a total distance of about twenty miles. Charles H. Hammond, Berkeley; Leon J. de Sabla, Samuel Lilienthal, San Francisco; George F. Springer, Oakland, and Herbert W. Furlong, Pleaston, are incorporators. A.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

FREMONT, NEB.—The Nebraska Telephone Company will soon erect a $60,000 exchange building here.

ALPINE, TEX.—The Pecos & Rio Grande Telephone Company has been granted a franchise in this place.

WARROAD, MINN.—Fox & Jewett are extending their telephone line east from Baudette to Clementson. C.

McKINNEY, TEX.—The Union Telephone Company has been incorporated with a capital stock of $75,000.

FULTON, MO.—The Buffman Telephone Company has been granted a franchise and will put in a $40,000 plant here.

AURORA, NEB.—The Hamilton County Telephone Association has purchased a lot and will build a modern exchange building. C.

CHISHOLM, MINN.—The Council is considering a plan, submitted by the Range Telephone Company, for an improved fire-alarm system. C.

SOUTH PASADENA, CAL.—The Pacific Telephone & Telegraph Company will install an underground conduit system in the city of South Pasadena. A.

MARIPOSA, CAL.—James D. Westfall and others have been granted the right to erect a private telephone line on and across the public roads of road district No. 5.

JASONVILLE, IND.—The directors of the Home Telephone Company are in the market for material to make extensive improvements. A new switchboard will be installed and new poles put up. S.

SIOUX FALLS, S. D.—The Northwestern Telephone Exchange Company has awarded the general contract for the central exchange building here to Hoy & Elzy, of St. Paul, and work will be started at once. C.

COLLEGE SPRINGS, IOWA.—Articles of incorporation of the College Springs Mutual Telephone Company, with a capital stock of $10,000, have been filed. J. W. Gibson, Ira Mitchell and A. M. Finley, are the incorporators. C.

ALPINE, TEX.—The Commissioners' Court of Brewster County has granted a franchise to the Pecos & Rio Grande Telephone Company to occupy certain streets of Alpine with its pole and cable lines. The company is preparing to make important improvements and extensions of its system. D.

SANTA ROSA, CAL.—The California Telephone & Light Company has been incorporated with a capital stock of $10,000,000 by J. E. Bennett, Palo Alto; F. L. Wright, Santa Rosa; A. H. Spurr and M. S. Sayre, Lakeport; and H. L. Ney, Kellogg. The company will operate at Santa Rosa and vicinity. A.

MARION, IND.—The Marion Telephone Company has filed articles of incorporation, capitalized at $100,000. The object of the corporation is to build, construct, equip and operate an automatic telephone plant, lines, telephones and exchanges, pole and underground work, and to do all things necessary for the operation and maintenance of a modern telephone system in Marion and other towns and cities in Grant and adjoining counties. Jerome Herff, George A. Southall, Edgar H. Johnson and David Blumenthal are directors. S.

MONTEPELIER, IND.—The United Telephone Company an-

nounces that it will make extensive improvements in the rural line service throughout Blackford County and lines radiating from the Montepelier exchange. A number of new lines will be built and a modern lockout system installed. S.

SELMA, CAL.—The Pacific Telephone & Telegraph Company is installing new equipment at its exchange here. The company will build an underground conduit system in the business district, and will make other improvements in its local lines. A. Terkell, district commercial agent, is in charge. A.

DEMING, N. M.—J. G. Moir and others are promoting the organization of a company here to construct a system of rural telephone lines to radiate out of Deming and cover the Mimbres River valley. The stock of the proposed company is being rapidly subscribed and it is expected that the work of construction will soon be started. D.

BILLINGS, MONT.—The Mountain States Telephone & Telegraph Company will make extensive improvements in its exchange and system at Billings; new underground and overhead cables will be installed. The work is estimated to cost $50,000. The company also plans for extensions in its toll-line system in this vicinity to total $250,000. A.

OWENSBORO, KY.—Russell & Brewster, of Chicago, have bought the controlling interest in the Rural Home Telephone Company, in Daviess, McLean, Hancock and Ohio Counties. The following officers were elected: Theodore Tyler, Chicago, president; W. B. McIlvaine, Chicago, vice-president, and L. N. Birk, Owensboro, secretary and treasurer.

SACRAMENTO, CAL.—Articles of incorporation of the California Telephone & Light Company have been filed. The company is capitalized at $10,000,000 and operates seven miles of telephone lines. The directorate is comprised of John E. Bennett of Palo Alto; F. L. Wright, of Santa Rosa; A. H. Spurr and M. S. Sayre, of Lakeport; S. Pickering, of Santa Rosa, and H. L. Ney, of Kellogg.

NEWCASTLE, IND.—In consideration of $25,000 the Newcastle Independent Telephone Company has turned its plant over to and abandoned the field to the Central Union Telephone Company. The later company will at once erect a telephone exchange building estimated to cost $150,000. After the first of the year rates for service will be increased from twenty-five to fifty cents per month. S.

ELECTRICAL SECURITIES.

Financial statements of the four Stone & Webster properties located in Dallas, Tex., for the fiscal year ending September 30, 1911, have been filed with the City Commissioners in conformity with provisions of the city charter requiring such action. These properties are the Dallas Electric Light & Power Company and the Consolidated, the Metropolitan and the Rapid Transit Street railways. For these four concerns there has been issued a total stock of $2,958,000. There is an indebtedness against these properties of $6,456,048 for bonds, notes, open accounts, accrual accounts and interest. Outstanding claims for damages against the four companies total $1,027,033. The income of the several companies during the year was $1,764,709 and the expenditures $2,065,130. Of these expenditures $76,458 was paid out as claims for damages and $450.522 for extensions and betterments of the property.

A new bond to come upon the market in January will be the five per cents of the Cumberland Telephone & Telegraph Company, to be issued in exchange for the minority stock of the company, according to the plan of absorption just announced by the American Telephone & Telegraph Company, the parent company. Although the stockholders of the Cumberland Company share the alternative of exchanging that stock for that of American Telephone at a price of 160 for Cumberland, it is thought that the bulk of the outstanding stock will be exchanged for the bonds, and that accordingly nearly if not quite $15,000,000 bonds will be issued. Being dated January 1, 1912, they will run twenty-five years and will be the only lien upon the company, except about $750,000 prior mortgage bonds. As the Cumberland Company has paid eight per cent dividends for a long period and has earned a surplus of from two to four per cent above its dividends the bonds will be amply secured and they are expected to prove a high-class investment.

DIVIDENDS.

Blackstone Valley Gas & Electric Company; quarterly dividend of one and one-half per cent, payable December 1.

Brooklyn Union Elevated Company; regular semiannual dividends of two and one-half per cent on the preferred and common stocks. Preferred dividend is payable December 31 to stock of record December 22. Common is payable December 7 to stock of record November 29.

Canadian General Electric Company; quarterly common dividend of one and three-quarter per cent, payable January 2.

Mackay Companies; quarterly common dividend of one and one-quarter per cent, and preferred of one per cent, both payable January 9.

Muskogee Gas & Electric Company; quarterly preferred dividend of one and three-quarter per cent, payable December 15.

Sao Paulo Tramway, Light & Power Company; quarterly dividend of two and one-half per cent, payable January 2.

Standard Gas & Electric Company, of Chicago; quarterly preferred dividend of two per cent, payable December 15.

Virginia Railway & Power Company; a semiannual dividend of two and one-half per cent on the preferred stock, payable January 8 to stock of record December 15.

United Railways & Electric, of Baltimore; semiannual preferred dividend of two per cent, payable on demand.

West Penn Traction Company; the regular quarterly dividend of one per cent on the common stock, payable December 15 to stock of record December 7.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Dec. 4.	Nov. 27.
Allis-Chalmers common	2½	3⅛
Allis-Chalmers preferred	11½	13
Amalgamated Copper	62⅜	63
American Tel. & Cable	*74	*74
American Tel. & Tel.	139½	141⅝
Brooklyn Rapid Transit	77½	77⅝
General Electric	152¾	155½
Interborough-Metropolitan common	15½	14⅞
Interborough-Metropolitan preferred	48	45
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	83	83
Mackay Companies (Postal Telegraph and Cables) pref.	72½	72½
Manhattan Elevated	134	134⅜
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	47½	48½
U. S. Steel common	63⅜	64⅛
U. S. Steel preferred	109	109⅛
Western Union	77¼	78
Westinghouse common	64½	65
Westinghouse preferred	*114	*114

*Last price quoted.

BOSTON.

	Dec. 4.	Nov. 27.
American Tel. & Tel.	139⅝	141½
Edison Elec. Illuminating	287	286
General Electric	152¾	155
Massachusetts Electric common	22	21¾
Massachusetts Electric preferred (ex. dividend)	93½	94
New England Telephone	150¼	150

PHILADELPHIA.

	Dec. 4.	Nov. 27.
American Railways	46	46
Electric Company of America	11⅞	12
Electric Storage Battery common	53¼	55
Electric Storage Battery preferred	53¼	55
Philadelphia Electric	16⅛	15¾
Philadelphia Rapid Transit	23	24
Philadelphia Traction	84½	84½
Union Traction	52	52⅜

CHICAGO.

	Dec. 4.	Nov. 27.
Chicago Elevated Railways common	28½	28½
Chicago Elevated Railways preferred	91	92
Chicago Railways, Series 1	95	95
Chicago Railways, Series 2	33½	33¼
Chicago Subway	⅝	⅝
Chicago Telephone	137½	140½
Commonwealth Edison	134	134½
National Carbon common	103	103
National Carbon preferred	118	118

PERSONAL MENTION.

C. A. TUPPER has again joined the Allis-Chalmers Company and is engaged in doing some special engineering work for that company.

J. H. SHOEMAKER, general manager of the Corn Belt Telephone Company, of Waterloo, Iowa, has resigned to go into other lines of work. His future home will in all probability be in Winnipeg, Can.

C. H. STOCKWEATHER has become connected with the Forest Service at Missoula, Mont., in the capacity of telephone expert. Mr. Stockweather was formerly engaged as engineer with the General Electric Company.

WILLIAM COALE, of the Sterling Electric Manufacturing Company, of Warren, O., spoke at the first regular meeting of the Manufacturers' Association of Sidney, O. Mr. Coale's address was on the subject of factory illumination.

C. C. HEEB, formerly Syracuse manager for the H. C. Roberts Electric Supply Company, has become associated with Pass & Seymour, Inc. Mr. Heeb will travel from the New York office, spending most of his time in Pennsylvania.

H. F. DICKIE, for some time superintendent of transportation of the Ohio Electric lines, with headquarters at Lima, O., resigned his position December 1. He will become general manager of a system of interurban and city lines at Boise, Idaho.

L. A. GARY, of Los Angeles, Cal., who for the past seven years has been connected with the Western Electric Company's telephone switchboard installation department, has severed his connection with that company. He has entered a private telephone engineering practice.

H. W. FULLER, general manager of the Washington Railway & Electric Company, Washington, D. C., has resigned to accept a responsible position with H. M. Byllesby & Company, of Chicago. Mr. Fuller will make his headquarters in Chicago, and will soon move to that city from the national capital.

T. AHEARN, president of the Ottawa Electric Railway and the Ottawa Light & Gas Companies has gone to Zurich, Switzerland. He is accompanied by W. H. Baldwin, hydraulic engineer of the Ottawa Electric Company. They are taking the trip to inspect the most advanced development of Continental public-utility systems in the interest of their companies.

D. McFARLAN MOORE, on Tuesday, November 28, lectured before a large class in the graduate course for college men in connection with the General Electric Company's lamp works at Harrison, N. J. Different types of the factory-built units of the Moore light, both white and yellow, were used in demonstration.

G. H. GLUCROFT, Bridesburg, Philadelphia, Pa., has resigned from the General Illuminating Company as consulting engineer and sales manager to connect with the Helios Manufacturing Company. While his especial attention will be turned to the sale of flaming arc lamps he will also market Helios arc lamps, storage-batteries, etc.

THOMAS B. DOOLITTLE, formerly of Boston, now residing at Branford, Conn., and CHARLES R. TRUEX, of New York, both long identified with Bell telephone interests, have been selected by President Theodore N. Vail as the additional members of the Executive Committee of the Telephone Pioneers of America. The Executive Committee now consists of: Thomas D. Lockwood, of Boston; John J. Carty, of New York; Francis A. Houston, of Boston, and Messrs. Doolittle and Truex.

JAMES G. POMEROY has been appointed sales manager of the Adams-Bagnall Electric Company with headquarters in Cleveland, O. Mr. Pomeroy has been manager of the Chicago office of this company for the past seventeen years. He will leave Chicago to make his home in Cleveland after January 1. "Jim" Pomeroy is without any doubt one of the most popular men in the entire electrical field. His record as a salesman and manager has been one of continued success, and he is known throughout the entire field as a man of the most genial and happy disposition, and with the reputation for integrity and steadfastness of purpose second to none. He began his career in the electrical business with the old Electrical Supply Company of Chicago, in 1881. Three years later he became associated with the Brush Electric Company, and in 1894 joined forces with the Adams-Bagnall Electric Company. Mr. Pomeroy was one of the organizers of the Electric Club of Chicago, serving as treasurer and as a member of the Board of Managers. He is an associate of the American Institute of Electrical Engineers, and Statesman-at-Large of the Sons of Jove. Other changes in the Adams-Bagnall Electric Company are as follows: C. L. Eshleman has been appointed publicity manager with headquarters in Cleveland, and the company has opened a Boston office under the management of E. R. Bryant, formerly connected with the company's New York office.

JAMES G. POMEROY.

OBITUARY.

ALDEN M. YOUNG, formerly of Waterbury, Conn., but for many years a resident of New York City, died suddenly Sunday night last at his apartment at Bretton Hall, in New York. Diabetes is supposed to have been the cause of death. Mr. Young had just returned from a visit to his daughter in Boston, and on going to his room, complained to the attendant of feeling ill, and expired while sitting in his chair. He leaves a widow and four married daughters, Mrs. Milton J. Warner, Mrs. John H. Goss, Mrs. George Milton Smith, and Mrs. H. D. Gallaudet. Alden M. Young was quite widely known in electrical circles, particularly in the lighting and railway fields. Born in 1853 in New York State, he spent his early life in Connecticut. Twenty years ago he came to New York City, and organized the Kings County Electric Light & Power Company, of Brooklyn, and in this and other organizations achieved substantial financial success. At the time of his death Mr. Young was senior member of the firm of Young & Warner, 30 Church Street, New York, and was president and director of the Connecticut Railway & Lighting Company, and Rockville Gas and Electric Light Company; vice-president and director of the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn; director of the American Power & Light Company, Corning Gas & Electric Company, Dayton Lighting Company, National Carbon Company, the American Gas & Electric Company, and Northern Westchester Lighting Company; treasurer and director of the Connecticut Power Company, the Norwich Gas and Electric Light Company, and the New London Gas & Electric Company; and was also connected with the administration of other companies. Mr. Young was president of the National Electric Light Association in 1899. The funeral was private, and the interment was made at Waterbury, Conn., on Wednesday of this week.

ALDEN M. YOUNG.

FRANK RIDLON, president of the electrical manufacturing house of Frank Ridlon Company, of Boston, died on Friday night of last week at the age of seventy-three years at his residence in Brookline, Mass. He leaves a widow and one married daughter, and was a member of the Ancient and Honorable Artillery Company of Boston. Mr. Ridlon was quite active in the affairs of the National Electric Light Association during the first ten or fifteen years of its existence, and possessed a wide acquaintance among the pioneer electric light men of the country.

LEGAL NOTES.

REASONABLE VALUE OF PROPERTY.—It would seem clear from the decisions that the most material question in cases of legislative rate regulation is that of the reasonable value of the property "at the time it is being used for the public"—that is to say, the time at which the question arises—it being upon the reasonable valuation at that time that the company is entitled to earn a fair return. The subject, speaking generally, may be viewed from many standpoints, as to which it may suffice to suggest that if the expenditures in the construction and equipment of a public-utility corporation have been absurdly extravagant and wasteful, it would not be admissible to say that such outlays fairly indicated the real value of its plant, nor that rates should be fixed upon a scale that would pay ordinary dividends upon a licentiously extravagant cost of property, and similar considerations might apply if fictitious values were the result of "watering" the stock. On the other hand, if property had been obtained at a price far below its real value in better hands or if some one of the many accidents or unsuspecetd reasons for a large increase should fortunately operate to double the value of a plant, it would not be just nor reasonable to confine the attention to the lower or former value, nor to say that such former value continued to be the real one. The value of a plant may depend upon good fortune, upon good management, or upon fortuitous circumstances, but in every event the reasonable value of the property "at the time it is used for the public" is the value to be ascertained. Cost of the plant at a much earlier date may throw some light on the question of value.—The United States Circuit Court, in Kentucky, in Cumberland Telephone & Telegraph Company vs. City of Louisville, 187 Fed. R., 637.

POWER OF CITY TO FIX RATES AND WHERE HELD REASONABLE.—The Supreme Court of Arkansas holds that a statute authorizing cities and towns upon complaint filed to examine the rates charged consumers for electricity and determine whether they are reasonable and "fix such prices to be paid for * * * electricity as they may deem to be a reasonable charge," will be read into every contract to which it relates, made since its enactment. Under such a statute a city has the power to examine the company's rates upon complaint made and, finding the charges unreasonable, to fix such rates as it deems reasonable. An ordinance fixing the rates does not impair the obligation of any contract had with it by the company or its predecessor made since the passage of the statute. The rates having been fixed by the City Council, which is given authority to investigate and determine reasonable rates, the presumption is that they are reasonable, and the burden of proof is upon the company to affirmatively show that they are not. Under the rates fixed by the city in the case before the court the company was shown to have acquired more new patrons in the same length of time than under its own rates, and to have realized more revenue from the sale of its current to its consumers in accordance therewith than under the rates made by it. There was also provided a uniform rate of charges against all customers using like quantities of the commodity, and the court holds that the presumption in favor of the reasonableness of the rates established by the city had not been overcome, and that the company had failed to show by clear, convincing, and unequivocal evidence, as the law required it to do, that the rates fixed by the city were unreasonable and effected a taking of its proprty without just compensation, so that its complaint was properly dismissed. The profit of the company upon its electrical fixture supply business, being realized from the capital of the company invested and the labor of its employes paid by and charged to the income derived from the sale of electricity to its customers, was a part of the business of the company, and should be estimated in determining the reasonableness of the rates fixed. —Arkadelphia Electric Light Company vs. City of Arkadelphia, 137 S. W. R. 1093.

FOREIGN TRADE OPPORTUNITIES.

(From Daily Consular Reports issued by the Bureau of Manufactures. In applying for information please mention file number.)

NO. 7618. ELECTRIC POWER PLANT AND CLARIFICATION APPARATUS.—A cablegram from an American consular officer states that the construction of an electric power plant of 10,000,000 units yearly, for use in connection with the clarification

of the water supply of a certain city, is contemplated. The officer adds that the water supply of the city in question is 15,000,000 gallons daily, but preference will be given to a clarification plant operated by electricity which will remove amber-colored vegetable stains and has a capacity of 1,000,000 to 5,000,000 gallons daily. He suggests that estimates by American contractors be submitted at once.

NO. 7645. TELEPHONE SYSTEM.—An American consul reports that the board of directors of a telephone company in his district intends to erect a modern telephone station and to install a new system that will accommodae 10,000 subscribers. The board is undecided as yet which system to adopt, whether to continue the present switchboard system or to substitute the automatic. The consulate has reliable information that no decision will be made in the matter until a commission, now on a tour of inspection in the United States, has made its report and findings, and, furthermore, that the installation will not take place within a year. There will be ample time for American firms desiring to compete for this business to investigate the matter in detail, and the consulate will be at their service at any time to aid in such investigation. English may be employed in correspondence.

NO. 7649. ELECTRO TECHNICAL GOODS AND MACHINERY.—A European business firm informs an American consular officer that it has extensive connections among manufacturers in various countries, and would like to get in touch with American manufacturers. It is of the opinion that if it could buy direct it would be able to do a fairly large business in American goods. The firm is especially interested in electrotechnical goods, machine tools, sheet-metal working devces, belting, traveling cranes, testing machines for building materials, valves, stuffing boxes, crucibles, etc.

NEW INCORPORATIONS.

INDIANAPOLIS, IND.—The Battley Electric Company has been incorporated by Robert S. Battley, William J. Battley and Dora Battley. The capital is $5,000.

BUFFALO, N. Y.—The Refillable Fuse Company has been incorporated by Thomas E. Boyd, Frank H. Kaiser, John G. Clemens and Henry Kaiser. The capital is $10,000.

SYRACUSE, N. Y.—Jutton Brothers Electric Company has been incorporated with a capital of $5,000 by L. O. Wadleigh, Bert G. Jutton, John Jutton and Frederick F. Jutton.

ROCHESTER, N. Y.—The Electric Wind Turbine Company was recently incorporated by Marc K. Comstock, Joseph C. Childs and Buell G. Tollman. The capital of the company is $150,000.

CHICAGO, ILL.—The Jenks Lantern Company has been incorporated with a capital of $16,000 by Harriet B. Jenks, Lloyd G. Spencer and W. H. Chapman. The company will manufacture and deal in electrical supplies.

CHICAGO, ILL.—The Perfection Storage Battery & Lighting Company has been incorporated to deal in electric generators, automobile appliances, etc. Carl E. Witters, George Lyons and John Welbrake are the incorporators.

NEW YORK, N. Y.—The Therapeutic Lamp Company has been incorporated with a capital of $100,000, by Samuel Bitterman, William A. Soles, Mason G. Worth and Julius Becker. The concern will manufacture electric lamps, etc.

NEW YORK, N. Y.—The Covic Electric Company has been incorporated to manufacture electrical machinery, etc. The capital is $10,000 and the incorporators are Myers & Goldsmith, Victor R. Greiff, Hugo Cohn, and Adolph Cohn.

CHICAGO, ILL.—The Solar Inverted Arc Lamp Company has incorporated with a capital of $10,000, to deal in gas and electric fixtures and appliances. The incorporators are David Broutman, Isadore S. Krinsky and Samuel Solomon.

CHICAGO, ILL.—The Electric Appliances Company has incorporated with a capital of $60,000 to manufacture electrical appliances, apparatus, etc. The incorporators are William W. Low, Thomas I. Stacey and William B. Walrath.

NEW YORK, N. Y.—The Reimers Manufacturing Company has been incorporated with a capital of $10,000 by William Hauser, Alfred E. Reimers, Morris H. Stevens and Catherine F. Calahan. The company will make electrical appliances.

NEW YORK, N. Y.—The Automatic Fire Alarm Company has been incorporated with a capital of $25,000 by Olney & Comstock, Richard S. Barnes, Thomas R. Brown and John D. Everitt. The company will manufacture electric fire alarms.

INDUSTRIAL ITEMS.

MONKS & JOHNSON, architects and engineers, No. 7 Water Street, Boston, Mass., have associated themselves with Henry F. Keyes, architect, of No. 161 Devonshire Street, Boston, for the preparation of plans and specifications for certain large industrial developments.

THE PEERLESS ELECTRIC COMPANY, Warren, O., lists in a recent folder a new line of single-phase induction motors ranging in size from one-twelfth to one horsepower. While the motors listed are all a frequency of sixty cycles, they can be furnished for other frequencies.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, O., has recently opened a branch office at 414 Bowles Building, Detroit, Mich., where a large exhibit of its electric and gas shades and reflectors and of their other products will be kept on display. The office is in charge of H. E. Richards, who is well known to the fixture trade of the middle West.

WALTER B. SNOW, Boston, Mass., announces the recent addition to the staff of Sidney G. Koon and John S. Nicholl. Mr. Koon was at one time editor of *International Marine Engineering* and later metallurgist for Jones & Laughlin Steel Company. Mr. Nicholl was previously with the New York Edison Company, and both are members of the American Society of Mechanical Engineers.

THE McROY CLAY WORKS, Brazil, Ind., shows, on its December advertising blotter, an illustration of an unusual conduit installation. A trestle, the picture of which is reproduced, is part of the conduit system of the Houston Lighting & Power Company, carries forty-nine McRoy single conduits laid seven high and seven wide. The trestle itself is 240 feet long and is supported on concrete pillars.

W. N. MATTHEWS & BROTHER, St. Louis, Mo., illustrates in a recent folder a number of installations of guy anchors in difficult places. The company also announces on an inclosed card that it is now making a stronger and better wrench for the Matthews anchor. These wrenches are to take the place of the old 560 and 707 wrenches and have been tested for the hardest kind of clay and gumbo soils.

THE HOOVEN, OWENS, REUTSCHLER COMPANY, Hamilton, O., describes its series N. Hamilton power pump in a recent bulletin. The features of this piece of machinery as given in the bulletin are that it is simple, light, economical to operate, and has a low upkeep expense. Complete descriptions of the various parts of the pump are given, and a number of drawings have been reproduced to aid in the explanation.

THE CENTURY ELECTRIC COMPANY, St. Louis, Mo., announces that the suit for alleged infringement of the Gutmann patents on electric motors (Nos. 458,162, 530,176, 530,177), which was decided against it in the United States Circuit Court on March 4, 1910, has been brought to retrial before the United States Circuit Court of Appeals for the Eighth Circuit. A decision was handed down on November 21 reversing the decision of the lower court and instructing it to dismiss the suit.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., describes its power machinery and apparatus in a number of recent bulletins sent out by the power and electrical department. Bulletin No. 1077 describes lighting transformers. Bulletins 1078 and 1082 take up alternating-current and direct-current machines, respectively. Direct-current motors and belt-driven generators, type K, are treated in Bulletin No. 1083, types H and HI being illustrated and described in Bulletin No. 1074.

THE ADAMS-BAGNALL ELECTRIC COMPANY, Cleveland, O., is working every department to full capacity. The early work on the Jandus line of fans is well under way and the flame-arc and inclosed-carbon-arc-lamp business is holding up in a most satisfactory way. The success of the company's new line of "ABolites" is phenomenal and daily orders are swelling the demand for these units beyond all expectations. The company's new manufacturing plant is rapidly nearing completion. The office and shop facilities are laid out on a basis insuring the highest efficiency in production, and the installation, in every detail, will be a model of its kind.

GEORGE HILLARD BENJAMIN, New York, N. Y., has issued a leaflet combating the prevailing impression that the terms of the Sherman Act and the construction of it by the Supreme Court in the Standard Oil and American Tobacco cases are directly opposed to the terms of such sections of the United States statutes as grant protection to inventors for their inventions for a specific term. Such impression, he states, is incorrect. In no one of the petitions filed by the Attorney General is there any allegation that the exercise of a monopoly specified in a patent or patents is in violation of the terms of the Sherman Act. The only restrictions are: (1) to prevent a control of the resale price of the patented article, and, (2) to keep the control of an industry out of the hands of those holding patents for a machine or process used in that industry.

DATES AHEAD.

American Institute of Chemical Engineers. Annual meeting, Washington, D. C., December 20-22.

American Association for the Advancement of Science. Annual meeting, Washington, D. C., December 27-30.

American Institute of Consulting Engineers. Annual meeting, New York City, January 16, 1912.

Western Electrical Inspectors' Association. Milwaukee, Wis., January 23-25, 1912.

National Independent Telephone Association. Annual convention, Chicago, Ill., February 7, 8 and 9, 1912.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 17-20, 1912.

The 1912 Boston Electric Show. Mechanics Building, Boston, Mass., September 28-October 26, 1912.

Directory of Electrical and Allied Engineering and Scientific Societies

(Published in the second issue of each month.)

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RECORD OF ELECTRICAL PATENTS.

Issued by the United States Patent Office, November 28, 1911.

1,009,731. METHOD OF FORMING ELECTRIC CABLES AND APPARATUS THEREFOR. H. W. Fisher, Pittsburgh, Pa., assignor to Standard Underground Cable Co., Air and moisture are exhausted from the core of the cable, insulating compound is then flooded into it and, simultaneously with its withdrawal from the compound, a lead sheath is applied.

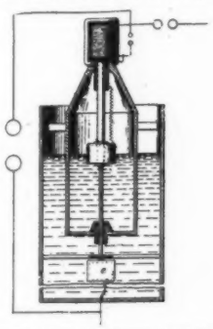
1,009,732. MACHINE FOR COVERING ELECTRICAL CONDUCTORS. H. W. Fisher, assignor to Standard Underground Cable Co., Pittsburgh, Pa. The conductor passes through a vertically adjustable insulating-compound tank and is at the same time wound with tape.

1,009,748. SWITCHING DEVICE FOR ELECTRICAL CIRCUITS. J. D. Hilliard and C. E. Parsons, Albany, N. Y. A solenoid-operated oil circuit-breaker specially constructed to break high-potential arcs.

1,009,762. TELEPHONE SYSTEM. R. H. Manson, Elyria, O., assignor to Dean Electric Co., Elyria, O. Provides meters on the subscribers' lines for measured service.

1,009,767. SHOE FOR THIRD-RAIL ELECTRIC CARS. L. A. McCoubrie and C. F. Raydure, Philadelphia, Pa. Relates to the method of supporting the shoe.

1,009,774. LOCK FOR ELEVATOR DOORS. P. Montgomery, Hartford, Conn. The doors are provided with electrically controlled locks; when one is open all the others are automatically locked.



1,009,748.—OIL CIRCUIT-BREAKER.

1,009,788. DYNAMO-ELECTRIC MACHINE. H. H. Ralston, Norwood, O., assignor to Bullock Electric Manufacturing Co. Each commutator segment has a radial slot with lateral perforations in which the connector tightly fits.

1,009,798. PRODUCING MUSICAL TONES. M. L. Severy, Arlington Heights, and G. B. Sinclair, Medford, Mass. Consists in generating a number of series of electric impulses, each series having most of its impulses tuned to some musical note and impressed on a sonorous body.

1,009,800. SIGNALING APPARATUS FOR SUBMARINE BOATS. J. F. Shea, Tampa, Fla. A raft carrying an autenna mast is connected to the boat by means of a hawser and an electric cable.

1,009,810. INSULATOR. T. H. Watkins, Wakpala, S. D. A porcelain insulator with a deep V-shaped socket having a plate and tongue for fastening the wire.

1,009,813. TELEPHONE SYSTEM. H. G. Webster, Chicago, Ill., assignor to Kellogg Switchboard & Supply Co. A party-line circuit is adapted to permit one subscriber to call and talk with another on the same line.

1,009,831. ELECTRIC DISTRIBUTION. J. C. Creveling, New York, N. Y., assignor to Safety Car Heating & Lighting Co. A regulator for a car-lighting generator includes an expansion member in the lighting circuit.

1,009,834. ELECTROTHERMAL SWITCH. J. Erickson, Chicago, Ill., assignor to First Trust & Savings Bank, Chicago, Ill. Has a disk of fusible solder rotatable to bring fresh portions into contact with a pin.

1,009,867. SPARK PLUG. G. O. Terry, Minneapolis, Minn. The electrodes are in the form of opposing split rings.

1,009,927. AUTOMATIC GATE FOR RAILWAY CROSSINGS. W. Noville, Cleveland, O. Is operated by an electric motor whose circuit is closed when an electric car approaches or leaves the crossing.

1,009,939. MANUFACTURE OF VAPOR ELECTRIC APPARATUS. P. H. Thomas, East Orange, N. J., assignor to Cooper Hewitt Electric Co., New York, N. Y. Mercury-vapor tubes are exhausted through connection to a secondary bulb with an intervening mercury seal.

1,009,940. VIBRATOR BOX. H. C. Thomson, Boston, Mass., assignor to Electric Goods Manufacturing Co. Has a condenser in the lower compartment directly to the vibrator contacts.

1,009,951. ELECTRIC DYNAMO AND MOTOR. E. J. Armstrong, Erie, Pa. A fan near one end of the machine draws air through an air filter in the casing and blows it through the machine.

1,009,956. AUTOMATIC CUT-OUT. G. W. Cravens, Chicago, Ill., assignor to Delta-Star Electric Co., Chicago, Ill. A cam near the hinge of the upper berth in a sleeping car opens a switch controlling the berth light when the berth is raised.

1,009,969. IGNITER FOR GAS LAMPS. F. W. Hill, Chatham, Pa. Electric igniter for acetylene burners.

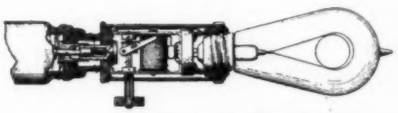
1,010,001. ELECTRODE-COVER FOR ELECTRIC FURNACES. J. L. K. Snyder, Cleveland, O., assignor to National Carbon Co., Cleveland, O. Filed Sept. 5, 1911. The lower part of the furnace cover is of conducting material and forms an electrode.

1,010,011. SECTIONAL INSULATOR. A. O. Austin, Barberton, O., assignor to Ohio Insulator Co., Mansfield, O. Consists of a series of alternate saucer-shaped porcelain insulators and tubular spacing members cemented together.

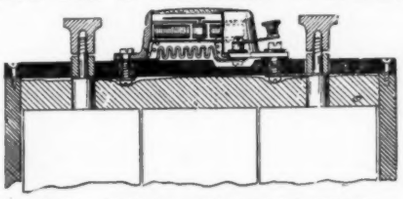
1,010,025. ELECTRIC REGULATION. J. L. Creveling, New York, N. Y., assignor to Safety Car Heating & Lighting Co. Resistance regulator in the lamp circuit of an axle-lighted railway car.

1,010,032. AUTOMATIC ELECTRIC SAMPLER. J. N. Flood, Denver, Colo. Oscillatory deflectors are actuated by means of solenoids whose circuits are periodically closed for a short time by a time switch.

1,010,058. ALARM DEVICE FOR LUBRICATORS. F. Lemann, Posen, Germany. Pendent chains supported by a float on the oil close an alarm circuit when the oil level is low.



1,010,125.—CURRENT TAP.



1,010,377.—STORAGE-BATTERY METER.

1,010,069. KNIFE SWITCH. H. L. Peat, St. Louis, Mo., assignor to Frank Adam Electric Co., St. Louis, Mo. The blade may be pivoted to either clip.

1,010,077. STRAIN INSULATOR. W. Schaake, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co. A rotatable nut and threaded bar provide for the regulation of tension.

1,010,083. TRANSFORMER. H. C. Soule, Wilkinsburg, Pa., assign to Westinghouse Electric & Manufacturing Co. An adjustable supporting cradle engages the upper and lower edges of the coils and supports them in vertical planes.

1,010,092. SMOOTHING IRON. T. G. Thomas, Houston, Tex. A number of incandescent lights are contained in the iron.

1,010,096. OVERHEAD STRUCTURE FOR ELECTRIC RAILWAYS. T. Varney, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co. A section-break device for trolley lines.

1,010,099. LIGHTING FIXTURE. F. W. Wakefield, assignor to F. W. Wakefield Brass Co., Vermilion, O. The body is adjustable and rotatable on the support.

1,010,118. COMMUTATOR BRUSH. J. L. Crouse, New York, N. Y., assignor to Westinghouse Electric & Manufacturing Co. An end plate is secured to the brush by means of expansible pins.

1,010,125. CURRENT TAP. H. L. De Zeng, Philadelphia, Pa. The brightness of the lamp is regulated by contact which varies resistance in series with a filament.

1,010,126. DYNAMO-ELECTRIC MACHINE. W. A. Dick, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co. Relates to the field windings.

1,010,134. COOLING DEVICE FOR ELECTRIC APPARATUS. C. L. G. Fortescue, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. A transformer tank is divided into two chambers through which oil is mechanically circulated, cooling being effected in oil-passage pipes external to the tank.

1,010,135. ALTERNATING-CURRENT MOTOR. V. A. Flynn, London, Eng. Has a squirrel-cage winding and a commuted winding in the same slots of the rotor, and a magnetic bridge lying above the permanently short-circuted winding.

1,010,160. RECORD MEASURING INSTRUMENT. P. MacGahan,

Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co. The record strip carrier is moved by a spring kept under stress by a motor.

1,010,165. INCANDESCENT LAMP. M. M. Merritt, Middleton, Mass., assignor to National Electrc Lamp Co., Cleveland, O. Renewal of the lamp filament is prevented by a metal ring contained in the lamp, any undue heating causing the ring to expand and fracture the bulb.

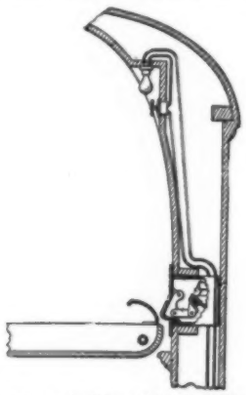
1,010,173. MECHANISM FOR MAKING AND BREAKING ELECTRIC CIRCUITS. W. H. Pierce and C. R. Parker, Syracuse, N. Y. Balls pressed together by springs form one terminal, the other being a knife rotating with an axle.

1,010,181. ELECTRIC-CABLE PROTECTOR. J. A. Sandford, Jr., East Liverpool, O., assignor to R. Thomas & Sons Co., East Liverpool, O. A shield of conducting material on the insulator protects the cable from an accidental arc.

1,010,191. ELECTRIC HEATER. H. D. Shelton, Hughesville, Mo. Filed Aug. 1, 1910. A hermetically-sealed water heater with a disc heating element made of coils of wire embedded in vitreous material.

1,010,197. X-RAY TUBE AND VACUUM CONTROL THEREFOR. H. C. Snook and G. H. White, Philadelphia, Pa., assignors to Roentgen Manufacturing Co., Philadelphia, Pa. Gas-liberating material is contained in a hollow neck arranged so that sparking between external terminals is prevented for any degree of vacuum.

1,010,211. ELECTRIC IGNITION SYSTEM OF INTERNAL-COMBUSTION ENGINES. F. H. Alston, Birmingham, Eng., assignor of one-half to B. Brooks, Birmingham, Eng. The magneto has



1,009,956.—BERTH LIGHT CUT-OUT.

two windings grounded in the middle, current being sent alternately through either half and reversed through the induction coil.

1,010,216. DYNAMO-ELECTRIC MACHINE. C. H. Bedell, Bayonne, N. J., assignor to Electro-Dynamic Co., Bayonne, N. J. A brush is placed directly beneath each commutating pole of a variable-speed motor.

1,010,224. TEMPERATURE INDICATOR FOR TEMPERING FURNACES. M. O. Bray, Rochester, N. Y. Has a series of temperature-controlled resistance circuits, the heating elements being automatically connected in circuit at predetermined periods.

1,010,245. ADVERTISING MEDIUM. G. T. Fielding, Jr., New York, N. Y. A sign made in the form of a box is made to open and close by an electric motor.

1,010,251. AUTOMATIC FIRE-ALARM. G. E. Glick, Carrington, N. D. An expansible element trips a lever closing the alarm circuit when a predetermined temperature is reached.

1,010,263. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. H. D. James, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co. Regulating switches have associated with them relay switches, interlocking switches causing each relay switch to close at a smaller value of current when the regulating switch preceding that with which it is associated is closed, than when the switch is open.

1,010,271 and 1,010,272. INDUCTION METER. R. C. Lanphier, Springfield, Ill., assignor to Sangamo Electric Co. Has two pairs of energizing poles and means for producing difference in phase between them. In the second patent, the meter has shunt and series-wound coils in co-operative relation.

1,010,277. ELECTRIC TIME SWITCH. C. J. Lindewald, Laporte, Ind., assignor to National Time Switch Co., South Bend, Ind. The switch is periodically opened and closed by clock work.

1,010,278. UNDERGROUND ELECTRICAL JUNCTION-BOX. S. J. Lisberger and C. J. Wilson, San Francisco, Cal., assignors to Pacific Gas & Electric Co., San Francisco, Cal. Relates to the arrangement of the busbars.

1,010,295. INCANDESCENT LAMP. M. M. Merritt, Middleton, Mass., assignor to National Electric Lamp Co., Cleveland, O. A weakened area causes the bulb to break when abnormally heated; thus preventing renewal.

1,010,307. LAMP-SHADE HOLDER. H. H. Palmer, New York, N. Y., assignor to F. E. Palmer, New York, N. Y. Resilient fingers are secured by a tie member.

1,010,371. ELECTRIC TRAIN-CONTROLLING DEVICE FOR RAILWAYS. R. T. Jones and F. T. Jones, Baltimore, Md., assignors to Jones Safety Train Control System Co., Baltimore, Md. An electromagnet on the train actuates the air brake valve when the track is blocked.

1,010,372. TRAIN-CONTROLLING MECHANISM. R. T. Jones and F. T. Jones, Baltimore, Md., assignors to Jones Safety Train Control System Co., Baltimore, Md. A modification of the preceding.

1,010,377. STORAGE BATTERY. H. H. Kempf, New York, N. Y., assignor to S. Johnston, New York, N. Y. An electric meter secured to the top of the cell is connected in circuit by a normally open key.

1,010,402. ELECTRODE FOR ARC LAMPS. J. T. H. Dempster, Schenectady, N. Y., assignor to General Electric Co. Is composed principally of a mixture of titanium oxide with ferruginous material.

REISSUE.

13,322. LAMP-SHADE HOLDER. J. Cruikshank, Shamokin, Pa., assignor of one-third to J. M. Dunketberger, Mount Carmel, Pa. Original No. 897,194, dated Aug. 25, 1908. Has a conical body with pressed guideways and slidable gripping members.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired December 4, 1911.

530,088. BRUSH FOR DYNAMO-ELECTRIC MACHINE. Pierre J. C. Carron, Pont-de-Claix-Isere, France.

530,093. ELECTRIC RAILWAY SIGNALING. William Daves, Jersey City, N. J.

530,114. METHOD OF AND MEANS FOR OPERATING AND CONTROLLING ELECTROMOTORS. Carl Moderegger, Vienna, Austria-Hungary.

530,115. TELEPHONE TRANSMITTER. Miles A. Morehouse, Wevertown, N. Y.

530,141. SERVICE END, CUT-OUT AND SWITCH BOX FOR ELECTRIC-LIGHTING CIRCUITS. John Van Vleck, New York, N. Y.

530,145. ELECTROMETER. Edward Weston, Newark, N. J.

530,176. ALTERNATING-CURRENT MOTOR AND METHOD OF OPERATING SAME. Ludwig Gutmann, Pittsburg, Pa.

530,177. ALTERNATING ELECTRIC MOTOR. Ludwig Gutmann, Pittsburg, Pa.

530,178. ELECTRIC CONVERSION SYSTEM. Ludwig Gutmann, Pittsburg, Pa.

530,184. CIRCUIT-CLOSER. Herbert V. Keeson, London, England.

530,192. ELECTRIC RAILWAY SYSTEM. David Mason, New York, N. Y.

530,208. TELEPHONE SWITCH. Alfred Stromberg and Androv Carlson, Chicago, Ill.

530,235. MAGNETO-ELECTRIC MACHINE. Joseph N. McLeod, Brooklyn, N. Y.

530,253. ELECTRIC BELL. Edward G. Worley, New York, N. Y.

530,260. PRIMARY BATTERY. Charles W. De Mott, New York, N. Y.

530,283. CONDUIT FOR ELECTRIC RAILWAYS. Michael I. Martin, Chicago, Ill.

530,286. ELECTRIC TRAMWAY. Heinrich Schweiger, Berlin, Germany.

530,293. ELECTRIC SWITCH. Ike W. Ullman, Birmingham, Ala.

530,315. TELEPHONE TRANSMITTER. John T. Williams, Brooklyn, N. Y.

530,324. TELEPHONE EXCHANGE SYSTEM. Romaine Calender, Brantford, Canada.

530,325. TELEPHONE SWITCH. Romaine Calender, Brantford, Canada.

530,343. ELECTRIC-LIGHT FIXTURE. Herman Horn, Philadelphia, Pa.

530,344. ELECTRIC DENTAL ENGINE. Joseph A. Jeffery and Benjamin A. Jeffery, San Francisco, Cal.

530,351. ELECTRIC METER. Gustav A. Scheefer, Peoria, Ill.

530,399. INSULATOR FOR ELECTRIC CONDUCTORS. John H. Croskey and Joseph Locke, Pittsburg, Pa.

530,401. BATTERY CONNECTION. Walter S. Doe, Brooklyn, N. Y.

530,412. TELEPHONE TRANSMITTER. John Goodman and Henry M. Goodman, Louisville, Ky.

530,416. SELF-LUBRICATING CONTACT BAR FOR ELECTRIC RAILWAYS. Frederick W. N. E. Hays, Berlin, Germany.

530,432. SYSTEM OF ELECTRICAL DISTRIBUTION WITH STORAGE BATTERIES. Emil Kuchenmeister, Berlin, Germany.

530,465. DYNAMO REGULATOR. John Van Vleck, New York, N. Y.

530,472. ELECTRIC SWITCH. John M. Cronin, Cambridge, Mass.

530,482. ELECTRIC RAILWAY SUPPLY SYSTEM. John J. Green, Boonton, N. J.

530,485. PRIMARY BATTERY. Charles J. Hubbell, New York, N. Y.